LONG-TERM IMPACT OF CHILDHOOD MALARIA INFECTION ON SCHOOL PERFORMANCE AND NUTRITIONAL STATUS AMONG SCHOOLCHILDREN IN A MALARIA ENDEMIC AREA ALONG THE THAI-MYARMAR BORDER

NUTCHAVADEE VORASAN

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……
Miss Nutchavadee Vorasan
Candidate

……
Asst. Prof. Saranath Lawpoolsri Niyom,
M.D., Ph.D. (Epidemiology)
Major advisor

……
Asst. Prof. Wirichada Pan-Ngum,
Ph.D. (Infectious Diseases)
Co-advisor

……
Lect. Podjanee Jittamala,
M.D. (Dip. Thai Board of Pediatrics)
Co-advisor

……
Prof. Patcharee Lertrit,
M.D., Ph.D. (Biochemistry)
Dean
Faculty of Graduate Studies
Mahidol University

……
Assoc. Prof. Kesinee Chotivanich,
Ph.D. (Pathobiology)
Program Director
Master of Science Program in
Tropical Medicine, Faculty of
Tropical Medicine, Mahidol University

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entitled

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was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Science (Tropical Medicine)
on
June 9, 2015

……
Miss Nutchavadee Vorasan
Candidate

……
Mr. Charles J. Woodrow,
Ph.D.
Chair

……
Asst. Prof. Saranath Lawpoolsri Niyom,
M.D., Ph.D. (Epidemiology)
Member

……
Lect. Podjanee Jittamala,
M.D. (Dip. Thai Board of Pediatrics)
Member

……
Asst. Prof. Wirichada Pan-Ngum,
Ph.D. (Infectious Diseases)
Member

……
Prof. Patcharee Lertrit,
M.D., Ph.D. (Biochemistry)
Dean
Faculty of Graduate Studies
Mahidol University

……
Prof. Yaowalark Sukthana,
M.D.(Hons.), D.V.M., Dip Thai Board of Oto-Rhino-Laryngology
Dean
Faculty of Tropical Medicine
Mahidol University

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Nutchavadee Vorasan

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NUTCHAVADEE VORASAN 5537191 TMTM/ M

M.Sc. (TROPICAL MEDICINE)

THESIS ADVISORY COMMITTEE : SARANATH LAWPOOLSRI NIYOM, M.D., Ph.D. (EPIDEMIOLOGY), WIRICHADA PAN-NGUM, Ph.D. (INFECTIOUS DISEASES), PODJANEE JITTAMALA, M.D. Dip. (THAI BOARD OF PEDIATRICS)

ABSTRACT

This is retrospective cohort study among schoolchildren age 6 and older in a primary-secondary school of Tanousri subdistrict, Suanphuang district, Ratchaburi province, Thailand, during 2014. History of childhood malaria infection was obtained from the medical records of the RTIC. School performance was assessed based on students' subject scores in Thai Language and Mathematics. Primary data was collected by interviews using questionnaires and standard emotional intelligence test. Data analysis was calculated using computer statistical package SPSS and the significant association was set at $p<0.05$.

A total of 457 students were included, 135 (30%) of whom had a history of uncomplicated malaria infection. About half of the malaria-infected children had suffered infection before the age of 4 years. Mean scores for both Mathematics and Thai Language decreased in relation to the increasing number of malaria attacks. Mean scores were not associated with duration since the last malaria attack. The association between malaria infection and school performance was not significant after adjusting for potential confounders. Malaria infection was also not associated with nutritional status after controlling for confounding factors.

This study investigated the long-term consequence of uncomplicated malaria during childhood. School performance and nutritional status were not associated with a history of malaria infection. These findings indicate that the impact of uncomplicated malaria infection on school performance and nutritional status may not be prolonged.

KEY WORDS: MARALIA / SCHOOL PERFORMANCE / NUTRITIONAL STATUS / EMOTIONAL INTELLIGNECE

135 pages

ผลกระทบระยะยาวของการติดเชื้อมาลาเรียในเด็กต่อความสามารถทางการเรียนและการประเมินภาวะโภชนาการในพื้นที่ที่มีการระบาดของโรคมาลาเรียในแถบชายแดน ไทย-พม่า

LONG-TERM IMPACT OF CHILDHOOD MALARIA INFECTION ON SCHOOL PERFORMANCE AND NUTRITIONAL STATUS AMONG SCHOOLCHILDREN IN A MALARIA ENDEMIC AREA ALONG THE THAI-MYARMAR BORDER

นุชชาวดี วรแสน 5537191 TMTM/M

วท.ม (อายุรศาสตร์เวชศาสตร์เขร้อน)

คณะกรรมการที่ปรึกษาวิทยานิพนธ์ : สารนาถ ล้อพูลศรี นิยม, M.D., Ph.D. (EPIDEMIOLOGY), วิริชดา ปานงาม, Ph.D. (INFECTIOUS DISEASES), พจนีย์ จิตตะมาลา, M.D. Dip. (THAI BOARD OF PEDIATRICS)

บทคัดย่อ

การศึกษานี้เป็นการศึกษาโดยใช้ข้อมูลย้อนหลัง (Retrospective cohort study) ได้ดำเนินการในนักเรียนกลุ่มอายุ 6 ปี ขึ้นไปในโรงเรียนประถมศึกษาและมัธยมศึกษาของ ตำบลตะนาวศรี อำเภอสวนผึ้ง จังหวัดราชบุรี ประเทศไทย ระหว่างปี 2557 ประวัติการติดเชื้อมาลาเรียในวัยเด็กได้รับจากเวชระเบียนของศูนย์โรคเขตร้อนนานาชาติราชนครินทร์ ความสามารถทางการเรียนได้รับการประเมินโดยใช้คะแนนจากวิชาภาษาไทยและคณิตศาสตร์ ร่วมกับการเก็บข้อมูลพื้นฐาน ซึ่งใช้แบบสอบถามโดยการสัมภาษณ์และแบบประเมินความฉลาดทางอารมณ์มาตรฐาน วิเคราะห์ข้อมูลโดยใช้โปรแกรมคอมพิวเตอร์ทั้งสถิติเชิงพรรณนาและเชิงวิเคราะห์โดยถ้าปัจจัยมีความสัมพันธ์กันจะต้องมีนัยสำคัญน้อยกว่า 0.05

นักเรียนเข้าร่วมการศึกษาทั้งหมด 457 คน, 135 (30%) ของนักเรียนมีประวัติการติดเชื้อมาลาเรียที่ไม่ซับซ้อน ประมาณครึ่งหนึ่งของเด็กที่ติดเชื้อมาลาเรียได้รับการติดเชื้อก่อนอายุ 4 ปี ซึ่งค่าคะแนนเฉลี่ยทั้งคณิตศาสตร์และภาษาไทยลดลงตามการเพิ่มขึ้นของการติดเชื้อมาลาเรีย ค่าคะแนนเฉลี่ยไม่มีความสัมพันธ์กับระยะเวลาของการติดเชื้อครั้งสุดท้าย ความสัมพันธ์ของการติดเชื้อมาลาเรียกับความสามารถทางการเรียนไม่มีนัยสำคัญต่อกันหลังจากควบคุมปัจจัยรบกวน อย่างไรก็ตามการติดเชื้อมาลาเรียไม่มีความสัมพันธ์กับภาวะโภชนาการด้วยเช่นกัน หลังจากควบคุมปัจจัยรบกวน

การศึกษานี้แสดงให้เห็นผลที่ตามมาในระยะยาวของโรคมาลาเรียที่ไม่ซับซ้อนในช่วงวัยเด็ก ซึ่งความสามารถทางการเรียนและภาวะโภชนาการไม่มีความสัมพันธ์กับประวัติการติดเชื้อมาลาเรีย การค้นพบเหล่านี้บ่งชี้ว่าผลกระทบของการติดเชื้อมาลาเรียที่ไม่ซับซ้อนอาจจะไม่ได้ส่งผลระยะยาวกับความสามารถทางการเรียนและภาวะโภชนาการ

135 หน้า

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LIST OF ABBREVIATIONS

CNS	Central nervous system
EQ	Emotional quotient
H/A	Height for Age
IQ	Intelligence quotient
PCR	Polymerase chain reaction
RTIC	Rajanagarindra Tropical Diseases Center
W/A	Weight for Age
W/H	Weight for Height
WHO	World Health Organization

CHAPTER I
INTRODUCTION

1.1 Rationale and Justification

The global burden of malaria infection

At the moment, the malaria infection is still a major public health problem worldwide. The World Health Organization explained that about 290 million malaria cases and 660,000 deaths occur around the world in each year. In previous studies, malaria infection more occurs in children. Furthermore, malaria infection was more serious in children (1-5).

Malaria is a vector borne disease cause by a parasite called "*Plasmodium*". There are five *Plasmodium* species including *Plasmodium falciparum*, *Plasmodium vivax, Plasmodium malariae, Plasmodium ovale* and *Plamodium knowlesi.* Malaria transmitted from *Anopheles* mosquitoes to susceptible human, and cause illness in human when malaria infected (6,7).

Clinical manifestation of malaria can be divided into uncomplicated malaria (a cold stage, a hot stage and a sweating stage), severe malaria (complicated by serious organ failures or abnormalities in the patient's blood or metabolism) and malaria relapses (patients having recovered from the first episode of illness may suffer several additional attacks after months or even years without symptoms). Malaria can be diagnosed by microscopic, antigen detection, molecular (PCR). Antimalarial drugs are now available for treatment of different species of malaria (6,7).

Malaria is endemic in many regions across the world. High malaria transmission is found in Southern Africa. According to WHO report, most of deaths due to malaria infection in children age under 5 years old occur in the Africa. In 2010, about 20% of total population in the American region is at some degree of risk to malaria disease. In the Southeast Asian region, 11 countries in the region remain the problem of malaria endemic. The major of high prevalence are Bangladesh, India, Indonesia, and Myanmar (1-3).

Malaria in Thailand

Malaria remains an important most problematic in rural areas of Thailand. The endemic areas along Thai international border are Thai-Myanmar, Thai-Cambodia and Thai-Loa. These areas usually cover with forest, which is suitable for mosquito bleeding place and transmission of malaria. The majority of population in these areas are still at risk for malaria infection, especially in children. The report from the Ministry of Public Health of Thailand showed the malaria incident case of 216,874 in 2012 (6,8).

Malaria in Ratchaburi province

Ratchaburi province is a malaria endemic area. In 2012, there were 3,219 reported malaria cases in this province, most of them were schoolchildren (6,8). According to previous research in the area along the Thai-Myanmar border, children and teenagers aged less than 16 years old are about two times more likely to get malaria attack than adults. Moreover, many of the children have multiple attacks within a year (6,16).

Children are more susceptible to malaria, because the children usually have no immunity for prevention of malaria and are more likely to develop very rapid to severe or complicated malaria. Children infected with malaria are more likely to have high fever and severe complications than adult. The parasite density influenced illnesses in children, while the increase parasite density related to lower red blood cell mass and immunological immaturity in children (9). Moreover, many studies explained that malaria infection can affect metabolism system in the body of children. Malaria changes the metabolism to hyper-metabolism due to fever. Malaria effects to occurrence of anemia in children. In addition, acute malaria infection or multiple attacks of malaria in children can induce anemia or iron deficiency, because malaria decreased hemoglobin level in human. Consequently, anemia or iron deficiency may influence the brain function of children, because in the brain, iron plays an important role in neurotransmitter synthesis; malaria infection may lead to damage in neurological system (10-12).

Malaria can affect neurological cognitive performance, both short-term and long-term. Malaria infection may affect brain function due to the toxicity effect and excitation of the immune system, which leads to biochemical changes in the

central nervous system. The effect may be most serious among young children, whom their brains are not maturely developed (11,12). The malaria infection can damage brain, because malaria infection cause decrease blood flow and induce hypoxia in the brain children. The hypoxia in the brain results in slowly development of the children brain, since their brain still develops over time. Previous studies found that hypoxia can cause brain damage via nitric oxide, in which nitric oxide is an important to systemic in the body affected to physiological processes, informatory processes and blood circulation. Nitric oxide released oxygen to various tissues via red blood cells. Decreased nitric oxide may lead to neuronal cell death. Several studies showed that malaria infection was associated with impairment neurological and cognitive performance. Previous studies explained that malaria could directly damage many parts of the brain, including hippocampal dysfunction and damage to sub cortical white matter. Thus malaria infection affects to impairments of memory formation and language function (9,12-14). Malaria associated with malnutrition and share consequences including cognitive impairment and decreased school performance. Malaria infection can indirectly affect cognition through nutrition. Moreover the previous study explained that children malaria infection associated with poor nutritional status (52).

Most previous studies followed effect of malaria infection on school performance in short-term or assess the two variables at the same time, such as cross sectional study or short duration (1-2 years) of cohort study. There is still lack of evidence on the long-term impact of malaria infection in children. This study assessed the long term impact of malaria with about 5-10 years of retrospective cohort study. Moreover there has been no study in Thailand about malaria and school performance. This study will provide knowledge regarding the effect of malaria in children, which will be useful for management of malaria and for planning prevention control of malaria in the country.

1.2 Research Question

Is malaria infection associated with school performance among schoolchildren?

Is malaria infection associated with nutritional status among schoolchildren?

1.3 Research Objective

1.3.1 General Objective

To examine the association between childhood malaria infection with school performance and nutritional status among schoolchildren in primary-secondary school of Tanousri subdistrict, Suanphuang district, Ratchaburi province, Thailand

1.3.2 Specific Objectives

1.3.2.1 To assess association between malaria infection and school performance on cognitive function (including grade of childhood and emotional intelligence) among schoolchildren.

1.3.2.2. To assess association between malaria infection and nutritional status among schoolchildren.

1.4 Hypothesis

Childhood malaria infection is associated with poor school performance and poor nutritional status.

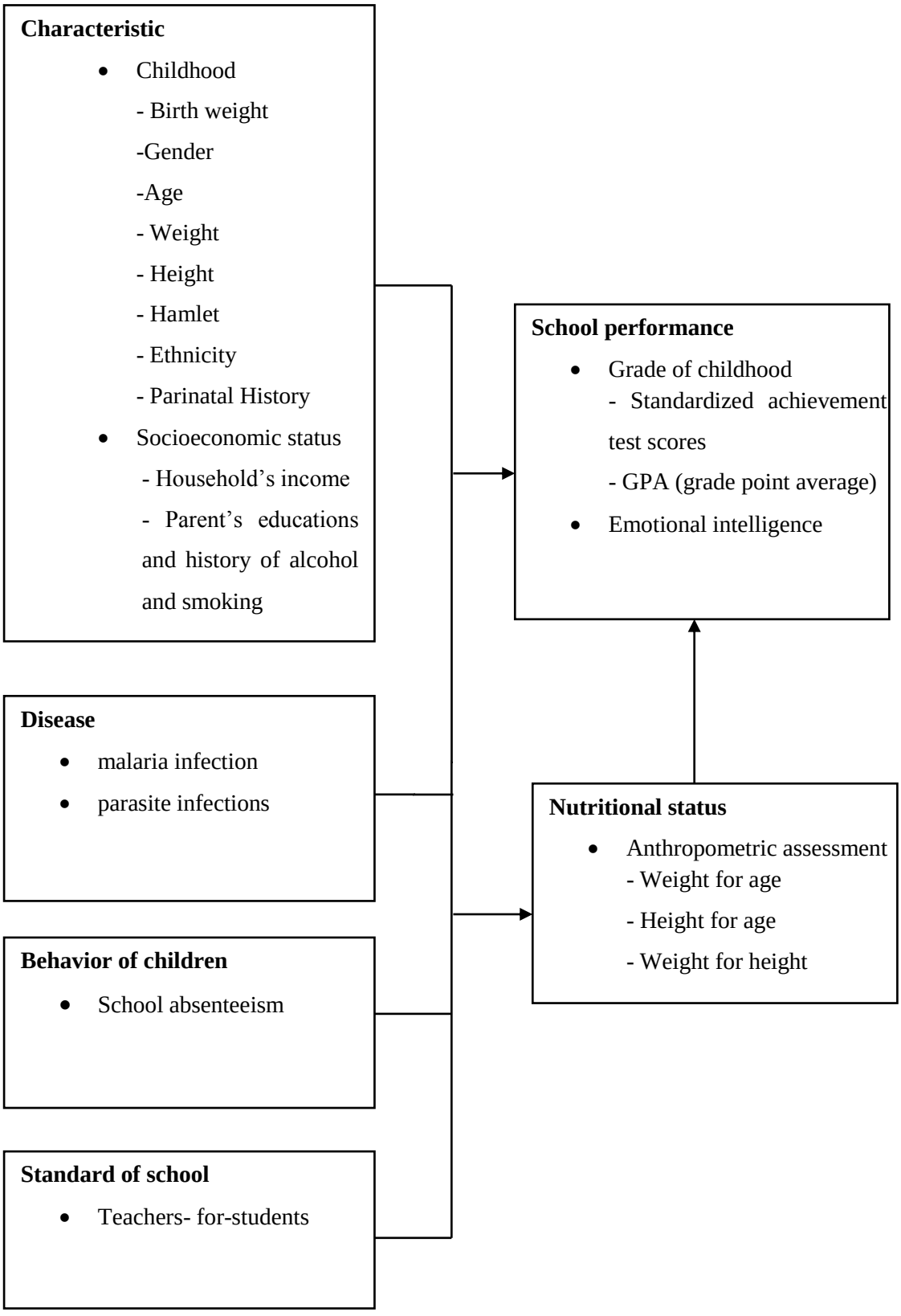
1.5 Scope of the Study

This Retrospective cohort study was conducted at the Rajanagarindra Tropical Diseases Center (RTIC), Suanphung district of Ratchaburi Province, located in western border of Thailand. The center, operated by the Faculty of Tropical Medicine, was established in 1994; since then the center has provided free diagnosis and treatment of malaria to about 4,000 residents. Each year, more than 500 malaria cases are diagnosed and treated at the RTIC. Among those, about 10% of the patients are children aged less than 5 years old. Because of logistical limitation, almost all malaria cases in the area are detected and recorded at the RTIC. There is only one school in the area, which provides both primary and secondary education. Primary-secondary school children, aged between 6-17 years old, were assessed for cognitive functions and nutritional status. Then their history of previous malarial infection was obtained from the medical record of the RTIC. This was allowed us to comparison the characteristics of childhood malarial infection according to the school performance of the children. Other potential confounders were identified and adjusted for the analysis.

1.6 Benefit

The findings of the project will provide new knowledge for improving the well-being of children living in malaria endemic areas, where across all transmission settings, children are still the most affected age group. On the other hand, the outcomes of this study will be useful for planning any future malaria prevention and management strategies.

1.7 Conceptual Framework



CHAPTER II
REVIEW OF THE LITERATURES

This chapter presents the review literatures of previous studies that involve and support for this study. The literature was respect to the following topics. The risk factor or the independent factor that association with outcome of interest. In this study is review literature about the factors associated with school performance and nutritional status in children.

2.1. Background of malaria

2.1.1 History of malaria

Malaria is a vector bone disease and caused by *Plasmodium spp*. There are five *Plasmodium spp*. including, *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale*, *Plasmodium malariae*, and *Plasmodium knowlesi*. *Plasmodium falciparum* can multiply rapidly and cause development to severe malaria and anemia in human. *Plasmodium vivax* can cause relapse due to hypnozoites hidden in the liver. The transmission of malaria occurs when a person is bitten by of *Anopheles* mosquitoes. Malaria parasite then move to the liver cell for development before infecting red blood cells which cause illness in human (6,7,15).

The intensity of malaria transmission depends on many factors such as the parasite, the vector, the immune in human and the environment or climate change. Malaria can cause wide range of symptoms, from asymptomatic, uncomplicated malaria (a cold stage, a hot stage, a sweating stage), severe malaria (effected to organ into the body and occurrence to failures in the body and may death) and malaria relapse (occurred after recovery without symptom). In children, malaria infection may be more severe (6,7).

Malaria diagnosis has many methods including, clinical diagnosis, microscope diagnosis, antigen detection to detect antigen malaria parasite, and molecular diagnosis which uses polymerase chain reaction (PCR) to detection malaria (6,7).

The treatment of malaria includes use of antimalarial drug to eliminate the parasite. At the moment, many cities around the world have report the drug resistance in malaria patients (6,7).

Malaria infection remains a major public health problem worldwide. WHO estimated that malaria occurs in 219 million and 660,000 died from the disease in 2010 globally. The malaria infection more occurs in Africa, where most death in children under five years old reported in this region (1-3,6,7).

In Thailand, malaria remains an important problem in rural areas. The endemic areas along Thai international border are Thai-Myanmar, Thai-Cambodia and Thai-Loa. The incidence was high in rainy season (6).

Ratchaburi province is an endemic area of malaria. This area is located along the Thai-Myanmar border, where a large area is covered by the forest. Moreover the reported malaria incidence was high in children (6,16).

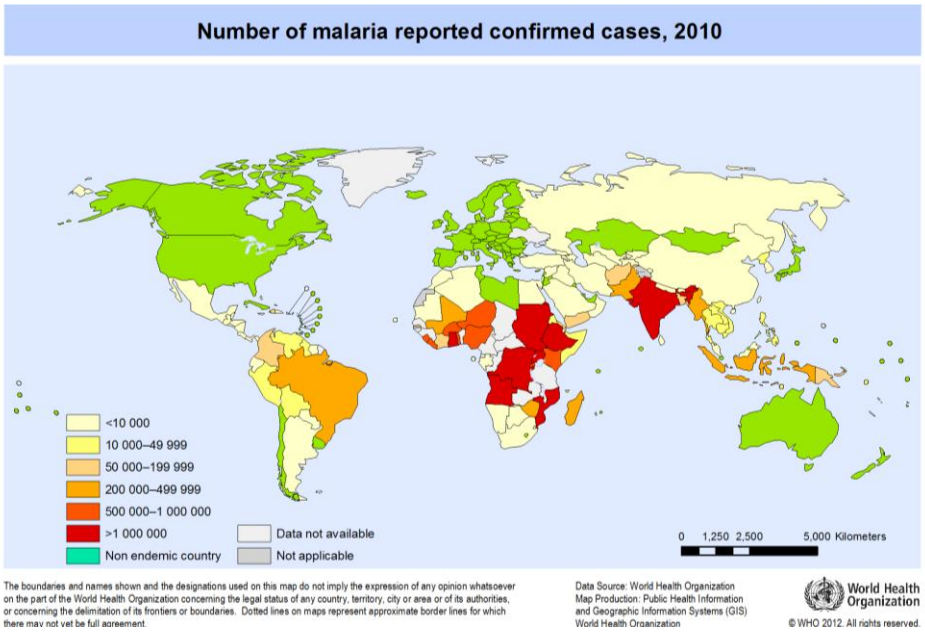


Figure 2.1 presents to malaria infection around the world in 2010

In malaria hyper-endemic areas, asymptomatic malaria infection may be commonly observed, because people may develop partial immunity against clinical disease due to repeated exposure of the parasite. However, in low malaria transmission area, such as Thailand, asymptomatic malaria infection is rarely observed.

2.1.2 Effect of malaria in children

Malaria has more effects in children. Malaria possesses a major problems in children including, acute febrile illness, cerebral damage, anemia, respiratory distress, hypoglycemia, malnutrition as well as nervous system related sequelae. Children are non-immune for prevention to malaria. Moreover the malaria infection among children can cause rapid development of severe or complicated malaria (17,18). Children are more likely to have high fever, severe vomiting and hypoglycemia than adult. Previous studies also demonstrated that high fever in malaria can increase metabolism rate in children (10). Moreover, malaria can cause anemia in children. Therefore, acute malaria infection or multiple attack of malaria in children can induce anemia or iron deficiency (9,10,19). Anemia or iron deficiency can influence brain function of children, because iron is involved in neurotransmitter synthesis, therefore iron deficiency may cause damage in neurological system (10-12).

Malaria is associated with malnutrition and share consequences including cognitive impairment and decreased school performance. Malaria infection can indirectly affect cognition through malnutrition. Moreover the previous study demonstrated that children with malaria infection associate with poor nutritional status than healthy children (10,52).

Malaria infection may affect brain function due to the toxicity effect and excitation of the immune system, which leaded to biochemical changes in the central nervous system. The effects of malaria were most serious among young children (11,12). However, malaria infection affect the brain in various process, such as cytokine, chemokine homeostasis, inflammation and damaged to vascular (11,12,20,21). Malaria infection can lead to lipid peroxidant damage to cellular and sub cellular membrane into central nervous system of children (21). John et al,

explained that TNF-alpha from malaria infection can damage CNS of children, which is associated with impaired neurological function (13,26).

Malaria infection can directly damage brain due to the decreasing of cerebral blood flow leading to the hypoxic neural cell in brain. Moreover, neuronal brain damage is possibly caused by the decreasing nitric oxide level (11-13).

Previous study explained pathophysiology of cerebral malaria including, changed red blood cells, host leukocytes and cerebral microvasculature. All the effects of malaria are related with intercellular junction proteins and intracellular signaling. Potchen et al. has demonstrated that malaria can cause damage to frontal lobes (association to retrieval information), temporal lobes and hippocampal dysfunction involved to the memory formation (13,23-25).

Malaria infection also leads to impairments of memory formation and language function, which subsequently affect school performance (9,12-14,15-17).

2.2 Intelligence/Intellectual and School performances

2.2.1 Definition of Intelligence/Intellectual and School performances

Intelligence involves to logic, understanding, self-awareness, communication, learning, having emotional knowledge, planning and problem solving (98).

Intellectual is a person who primarily uses intelligence in either a professional or an individual capacity and the product the life of mind. The general term of intellectual is learning, erudition and informed of critical thinking. However, the intellectual is a specific variety of intelligent that associated with reason and thinking of an individual (99).

School performance or academic performance was the difference of an individual intelligence that influence to outcome of education (3,27).

School performance is academic achievement, cognitive and language skills of the children as well as intellectual outcome (38-40). The cognitive abilities require working memory, reasoning, learning, visual spatial skills, attention. Standard of academic performance involves reading, spelling, and arithmetic. Many studies

explained that reading and arithmetic skills depend on individual's cognitive ability. Furthermore the cognitive ability and academic performance influenced to education level of children (38-40).

School performance is related to behavior (internalizing and externalizing problem) and experience in individual of children. Moreover, school performance has been shown to associate with age, nutritional status, socioeconomic, cultural, familial and demographic. Therefore, many factors affected to intelligence and related on school performance (40, 41).

School performance is also associated with emotional and academic achievement. Children with emotion problems may present with poor school performance (35-36).

2.2.2 Instruments to measurement intellectual/intelligence and school performance

There are many method for measurement intelligence or intellectual and school performance, such as intelligence test and conscientiousness (3,27).

School performance can be assessed by teacher questionnaire and standardized tests score compared with their children in same classroom (28). Common standardized academic achievement tests are reading and mathematics (29). Many studies assessed school performance or academic performance by using standardized achievement test scores (score in mathematics and score in language) and a grade point average (GPA) (30-33). Sattler discussed that abilities of children in learning and skills can be assessed, from many of subjects including reading, writing and mathematics (33,34).

Many studies in cognitive abilities or cognitive function used the WISC (Wechesler Intelligence Scale for children) and Stanford-Binet for assessment school performance. WISC has subtest for testing Autism and this test can directly evaluate high functioning intellectual and school performance of individual. However, this method measures direction magnitude of the difference between verbal and performance intelligence quotient. WISC has been applied to the interpretation of intellectual strengths and weaknesses and to the diagnosis of clinical disorders. WISC III is including, Basic Reading, Reading Comprehension, Numerical Operations,

Spelling, and Written Expression(100). But this test requires a psychologist to perform the test (41). Average normal intelligence of person is 100 (100).

A pervious study assessed school performance and emotional including, the mathematical knowledge, mental computation, concentration, attention span sort term memory, motor coordination and speed of mental operation (37). In Thailand, emotional intelligence is assessed by a standard emotional intelligence questionnaire, created by the Ministry of public health of Thailand.

Assessment of children intellectual from school performance is easy to use in field trials, and many evidences have shown its usefulness and reliable. Sheila et al. conducted a cohort study in Brazil in 2008. The study assessed school performance by using final score in Language and Mathematic (52). Moreover, Fernando et al. conducted a prospective cohort study in Sri Lanka in 1997. The study assessed school performance by score examination in Language and Mathematic (30). So these evidences suggested that assessment of school performance by considering score examination in language and Mathematic would be appropriate to use.

The assessment of school performance in terms of grade or GPA has two disciplines including, Language and Mathematics because both are taught to children in all grades. The assessment of school performance was evaluated by teacher's evaluating system. The range of the final score is from 0 to100. In each grade or classroom, poor school performance is usually considered when the final score below 50 percentile of classroom. This was done to avoid the bias of evaluation by different teachers with the intent to compare with children with their colleagues group (52).

In Thailand intelligence of children was higher in Bangkok, about IQ = 104.5 and lower in Northeast of Thailand, IQ = 95.99. The normal emotional intelligence is 91 - 110 and maximum is 131-140 (100).

In Thailand, emotion of children was assessed by emotional intelligence test. The emotional intelligence test of children can be divided into age 3-5 years old, 6-11 years old and 12-17 years old. The emotional intelligence for children age 3-5 years and 6-11 years were assessed by teacher. The emotional intelligence for children age 12-13 years was assessed by themselves (76,77).

In 2012, the survey of emotional intelligence in Thailand was monitoring the level of emotional intelligence of school children aged 6-11 year. The

standardization score of emotional intelligence of children in Thailand was 45.12, indicated that emotional intelligence of most children was moderate (76,77).

In 2005, a cross sectional study in Southern of Thailand was conducted to determine the Thai Emotional Intelligence Screening Test for ages 12 -17 years old. The result presented that 64 % of children had good scores of emotional intelligence, 41.27 % had normal acuteness, and 41.38 % had normal happiness. Overall, 78.38% of children had normal emotional intelligence in this study (81).

2.3 Nutritional status

2.3.1 Definition of nutrition status

Nutritional status is the diet to intake into the body of individual. The diet intake keeps into the body for the composition and function of the each individual. Moreover, the diet gave to support the healthy with the normal range an individual. The nutrients and abilities of the body had level, so the body to maintain normal metabolism integrity for sufficient (equilibrium or balance) of an individual. However the diet increased in the body more than normal range and the diet decreased more than the normal range, therefore the body imbalance influenced to occurrence disease. The body disequilibrium changed metabolism in the body, so occurred the malnutrition status in the individual. The nutritional status used anthropometry for assessment level of malnutrition (42,43).

2.3.2 Assessment of nutritional status

The world health organization used the anthropometry for assessment the nutritional status in children. The world health organization collected to standardization data around the world and set the standard for compared wide range with the standard of assessment nutritional status in children. The nutritional status explained about the health status or malnutrition and identifies group of individual for particular nutritional interventions (44).

The nutritional status was assessed by evaluate adequate nutrition in children. Nutritional status in children had more an important. According to the

previous studies, the children occurred to malnutrition, therefore the children with malnutrition related to growth and illness in children. Many methods used for assessment of nutritional status in children. For the reviews many studies assessed association between anthropometry indicator for evaluating malnutrition in the children and growths with the diet intake and qualities of life in the children (43,45).

In a previous study, assessment of nutritional status was divided in 2 groups including

1) Community assessment, the data explained average of that community. This method was easy and simple to assessment to nutritional status (46).

2) Individual assessment, the data was specific in each person. This method was intensive evaluation to nutritional status. Therefore, many studies assessed nutritional status in children by this method (46).

The method to assessment of nutritional status in children and adult were similar, but the standard guideline was different between children and adult. This is divided in two methods including

(1) Direct method was including anthropometry, body composition assessment, physical examination, biochemical assessment and biophysical methods of assessment (46).

(2) Indirect method was inquired by near person with patient and collected to secondary data for assessment nutritional status. The method was history taking, dietary survey, vital statistic, age-specific mortality rate, morbidity, cause-specific mortality rate and nutritional relevant disease (46).

2.3.3 Anthropometry Assessment

In a previous study anthropometric indices assessed the children growth status (45). There were many methods including

- Weight for age (W/A) was the measurement compared the standard weight in children to the same age and gender. The method explained to a convenient synthesis of both linear growth and body proportion. This method got to aware date of birth of children (45,46).

- Height for age (H/A) was the assessment of height compared with age and portrays performance in terms of linear growth, and essentially measured long-

term growth faltering for described past nutritional status. This method similarly in weight for age in term of the method got aware date of birth of children (45,46).

- Weight for height reflects body proportion, or the harmony of growth, and was particularly sensitive to acute growth disturbances. This method explained to present of nutritional status (45,46).

In a previous study calculated percent weight for height (W/H) to percentile 50^{th} (46).

Table 2.1 Waterlow's classification of nutritional status (%W/H) (46).

Grade	(%W/H)
Grade 0	>90 %
Grade 1	90 - 80 %
Grade 2	< 80 - 70%
Grade 3	< 70 %

For a previous Indonesia study classified the nutritional status of school children and assessed by weight for height index, because the method evaluated a simple screening method for detection of malnutrition. This method recommend from Health Department of Republic of Indonesia. Nutritional status divided into six categories (47).

Table 2.2 Classification of nutritional status of Indonesia (47).

Obese	> 120 % (the percent values indicate the weight-for-height index)
Over weight	110 - 120 %
Mal–good nutrition	90 - 109%
Mild malnutrition	80 - 89%
Moderate malnutrition	70 - 79%
Severe malnutrition	70%

The assessment of nutritional status provided conclusion in terms of growth (47).

In Thailand, 3 methods (W/A, H/A, W/H) were recommend for assessment nutritional status in children and followed to Ministry of Public Health of Thailand.

- Weight for height was the children loss of diet and effected to wasting. This indicator explained about present of nutritional status. This method is measured within the same age but different height (48).

Table 2.3 Weight for height followed to Ministry of Public Health of Thailand

Obesity	> +3 SD
Over weight	> + 2 SD to +3 SD
Mal–good nutrition	> 1.5 SD to 2 SD
Normal	1.5 SD to +1.5 SD
Relatively thin	<-1.5 SD to -2 SD
Thin	< -2 SD

- Weight for age explained the relation between growths with age of children. The method assessed the protein energy and classifies including (48).

Table 2.4 Weight for age followed to Ministry of Public Health of Thailand

Overweight of standard	>+2 SD
More weight of standard	>+1.5 SD to +2 SD
Normal standard	-1.5 SD to +1.5 SD
Less weight of standard	<-1.5 SD to -2 SD
More less of stand	<-2 SD

- Height for age measured between height within the same age of children and explained that the past of nutritional status or acute of loss intake protein (48).

Table 2.5 Height for age followed to Ministry of Public Health of Thailand

Over height	>+2 SD
More height	+1.5 SD to +2 SD
Normal	1.5 SD to +1.5 SD
Relatively Stunting	<-1.5 SD to -2 SD
Stunting	<-2 SD

For all methods were summarized the intensive of nutrition status in children (48).

Anthropometry is the single most portable, universally applicable, inexpensive, and noninvasive method available to assess the proportions, size, and composition of the human body. It reflects both health and nutrition and predicts performance, health, and survival. For these reasons, it is used for selecting individuals and populations for health and nutrition interventions, as well as for monitoring their health and nutrition (101).

Advantage of weight-for-height is that it can be calculated without knowing age, which makes it useful in populations that do not record dates of birth or for whom such information is unavailable or unreliable (102).

Disadvantage of weight-for-age is primarily a composite index of both weight-for-height and height-for-age and fails to distinguish tall, thin children from those who are short with adequate weight. The use of weight-for-age for predicting or identifying "wasted" children was found to have a low sensitivity and specificity in three U.S. populations (102).

2.4. Factors associated with school performance

2.4.1 Gender of children

A study of Uganda assessed between malaria with academic performance. This study explained that about more than half of respondent was male and included to risk factor of poor school performance (49).

In household-based cluster-controlled intervention trail of Gambia assessed long term of malaria in children on school performance. The finding found that female significant associated with school enrolments more than male (p=0.013) (34).

A cross-sectional study in Philippines assessed the risk factors on school performance. The results found that male was statistically no significant associated with school performance OR= 1.90, 95% CI = (1.17-3.09) (50).

A historical study in southern Sri Lanka was assessed malaria infection on school performance. The characteristic of children found that 50.4 %was male and 49.6 % was female (51).

The study in Amazonas, Brazil assessed malaria infection among children on school performance. The characteristic in this study found that more than half of children were male (52).

2.4.2 Age of children

A study was conducted in southern Sri Lanka to examine impact of malaria infection on school performance. The study was carried out in children age 6-14 years old. The majority of children were age between 6-12 years old and only 13% were below 12 years old (51).

In 2009, the study was conducted in Amazonas, Brazil to assess the impact of malaria infection in children on school performance. Age of children divided into two groups including, 6-10 years old and 11-14 years old. The finding showed age of children no statistically associated with poor school performance after controlling for confounding factors (Adjusted Odds Ratio =1.70, 95% CI = 0.94-3.04, *P* = 0.077) (52).

A case-control study in Uganda assessed the outcome of malaria with neurological involvement in children 5-12 years old. The study explained that children without malaria were older than children with malaria group (p=0.01) (53).

The study was assessed malaria infection on school performance. In this study the rage of age was 5-12.25 years old, the mean age in children was 7.33 years old and standard deviation was 1.69 years old (39).

A cross sectional study in two endemic areas in Sri Lanka was examined impact of malaria infection in children on school performance. The representative in this study was children age 5-6 year old (54).

The study assessed short term of malaria infection on school performance in children living in Sri Lanka. This study was carried out in four schools among students age 6-11 years old (55).

In 2001, the study was conducted in Gambia to finding the associated between malaria chemoprophylaxis on cognitive abilities and school educational attainment. The results showed that median age of children were 17 years 1 moth (range 14 years 9 months to 19 years 6 month) (34).

2.4.3 Weight of children

A study in Kampala, Uganda assessed the long-term impact of cerebral malaria in children with school performance. The results showed that weight of children no statistically significant associated with long-term impact of cerebral malaria and school performance (p= 0.61) (56).

The cross-sectional study was conducted in Leyte of Philippines. The study assessed the effects of four helminthes infection. The nutritional status measured by Body Mass Index (BMI). The result showed statistically significant associated between nutritional status and poor school performance (OR= 0.017, 95%CI= (0.10 - 0.29). This study explained that children among low BMI had higher risk to poor school performance than normal BMI children (50).

2.4.4 Perinatal History

Gestational age at birth

A longitudinal study assessed to school performance with lest preterm (34-36 wk) infants. The results score of reading and mathematics in lest preterm infants had lower than full term infants group (82).

A prospective longitudinal study was conducted among children born at 24 – 31 weeks of gestational age at 10 years of age. The result presented that the full term children were more likely optimal school outcome than preterm children (odds ratio= 3.4, 95% CI 1.9-6.0) (83).

A previous study was conducted in children born between 32 and 35 weeks gestation at 7 years of age. This study assessed to preterm children with educational outcome or school performance. The results presented that the preterm children was significantly poor school performance including test of writing motor skill, mathematics specking and reading (84).

A previous study in Australia conducted in adolescents born small for gestational age at 14 years. The study assessed learning and cognitive with small gestational age. The result found that adolescents who were born small for gestational age were more likely to experience learning difficulties compared with full term children. The conclusion suggested that small gestational age had effects on learning, cognition, and attention in adolescence (85).

A study conducted among the children born 33-40 weeks gestational age between January 1990 and June 1992. This study determined the association between gestational age and child's school performance at the age of 10 years. The results found that children born 33- 36 weeks of gestational age had 50% increasing risk of reading difficult compared with the children born 39-40 at term of gestational age (86).

Low birth weight

A pervious cohort study was conducted among very-low-birth-weight infants born in 1977-1979. This study assessed the level of education, cognitive and academic achievement at 20 years of age. The children with very-low-birth-infants had lower IQ and academic achievement compared with normal-birth-infants ($p<0.001$) (87).

A regional cohort study in Australia was conducted in children with extremely low birth weight who born during 1991-1992 to 8 years of age. This study assessed the extremely low birth weight with cognitive and educational. The result in the study found that extremely low birth weight significantly lower score of full scale IQ (including, reading, spelling, and arithmetic) compared with normal birth weight ($p<0.001$) (88).

A longitudinal study assessed school performance at 8 years for children with birth weights of 1250 g or less. This study found that very low birth weight group less likely in test of mathematics, spelling and reading. Moreover, low birth weight

group had statistically significant associated with poor school performance in term of mathematics, spelling and reading (89).

A study was conducted among children born 33-40 weeks gestational age between January 1990 and June 1992. The study assessed to gestational of age and birth weight with child's school performance at the age of 10 years. This study presented that the children who weight less than 2,500 g having highest risk to learning disability compared with children who weight more than 3,000 g. In conclusion of the study suggested that low birth weight associated with poor school performance (86).

Complication during birth

A previous study assessed school performance in children who had neonatal encephalopathy with birth asphyxia as term infants at 8 years of age. This study found that children with moderate or severe encephalopathy were associated with poor school performance including, reading, spelling, and arithmetic grade levels (p<0.01) (90).

A previous study was conducted among children aged 8 years old who had history of bronchopulmonary dysplasia (BPD). This study examined the effects of bronchopulmonary dysplasia (BPD) on cognitive and academic achievement of children at 8-years-old. This study explained that 20 % of BPD children achieved full-scale IQ scores <70. In conclusion of the study, long term oxygen exposure and BPD in children can affect cognitive and academic achievement (91).

A pervious study assessed the association of intrauterine fetal growth retardation and learning deficits at age 9 to 11 years. The result presented that fetal growth retardation associated with learning deficits (92).

Vaccination history

A prior prospective study was conducted in Los Angeles. This study assessed the nature and rates of adverse reaction occurring with 48 hours following Diphtheria-Tetanus-Pertussis (DTP) immunizations. The study found that 9 children had convulsions and 9 children had hypotonic-hyporesponsive episodes. After an interval 6-7 years, contacting of contacting the families of 16 of these children to determine whether had evidence of neurological impairment. The results showed that no children had significant neurologic deficit. Psychometric testing revealed normal

performance IQ scores (104.3 ± 15.8) but low verbal IQ scores (91.8 ± 18.4). However, these lower verbal IQ scores can be explained by the proportion of Hispanic and bilingual children in this sample (93).

2.4.5 Hamlet of children

Cross sectional study assessed helminth infection and cognitive impairments among children. This study was carried out in rural village in Philippines (50).

A study was conducted in 15 villages of the town in Farafenni, Gambia and on the north bank of river of Gambia. This study assessed long-term impact of malaria chemoprophylaxis on cognitive abilities and educational attainment (34).

Many previous studies was carried out in malaria-endemic areas such as, in Southern Sri Lanka and in the Municipality of Careiro, Amazonas, Brazil (51,52).

2.4.6. Ethnicity of children

A previous study assessed the association between school grades and achievement test scores. The results explained that ethnic group differences emerged in parents' expectations for children's educational attainment, grade expectations, and in the relations between these beliefs and children's school achievement (95).

In previous study suggested that children among ethnic minorities had affects by poverty and influenced to experience of more academic failure. This study explained that children minorities had risk to under education or poor school performance (105).

2.4.7 Socioeconomic status of children

A previous research was conducted in a malaria-endemic area in Sri Lanka. This study assessed malaria infection in children on school performance. In this study found that more than 70% of households had family income per month less than 3,000 Sri Lankan Rupees ($36 U.S.dollars) and almost 60% of the families were living in medium or poor houses, indicating that the poor rural socioeconomic background of this population. The results of the study presented that both language and mathematics scores were significantly associated with family income per month

(P < 0.001), and the house type (P < 0.001). Furthermore, children from low socioeconomic status associated with poorer school performance (51).

A cross sectional status was carried out in Leyte, Philippines. The study assessed effects of parasite infection in children on school performance. However, the socioeconomic status was no associated with poor school performance (Odd ratio = 0.71, 95% CI = 0.64, 0.78) (50).

A case-control study at Kampala City in Uganda assessed on cognitive ability and academic performance. The socioeconomic status parent among malaria group was 3.8% and without malaria group was 3.16%. The results presented that no statistically significant associated between cognitive ability and academic achievement P = 0.19 (53).

2.4.8 Parent's educations of childhood

Mother's education

A study was carried out in a malaria-endemic area in southern Sri Lanka. This study assessed impact of malaria infection on school performance. The results presented that mother' education were uneducated 36 (6.3%), grade 1–5 = 186 (32.6%), grade 6–10 = 252 (44.1%) and grade 10 = 97 (17.0%). Moreover, mother's education had associated with the lower score of special test (P < 0.001). This study explained that children who had less educated mother associated with poor school performance (55).

A previous study in Brazilian Amazon in 2008 assessed malaria infection and school performance among children living in an endemic area. In the study showed that children among mother's education less than 5 years had higher risk 1.98 times to poor school performance than children among mother's education more than 5 year (Odds Ratio =1.98, 95% CI= (1.02-3.85), *P*=0.030). However, after controlling for confounding factors showed that no associated between mother's education and poor school performance (Adjusted Odds = 0.56, 95% CI = (0.30-1.06), *P*= 0.076) (52).

In 2001, the cluster-controlled intervention trial conducted in Gambia assessed long term impact of malaria chemoprophylaxis on school performance. The results presented that children who had uneducated mothers were 38.11% and 41.30%

(Prophylaxis group and in placebo group respectively), moderate educated mothers were 48.60% and 48.19% (Prophylaxis group and in placebo group respectively), primary educated mothers were13.29% and 10.51%% (Prophylaxis group and in placebo group respectively) (34).

Father's education

A previous study assessed acute attack of malaria infection on school performance in children in Sri Lanka. The results presented that father's education were uneducated (3.1%), grade 1–5 = 227 (39.8%), grade 6–10 = 232 (40.6%) and grade 10 = 94 (16.5%). Moreover, the result found that the score of special test associated with father's education ($P < 0.001$). This study explained that children who had less father's education associated with poor school performance (55).

The cluster-controlled intervention trial conducted in 2001 at Gambia assessed long term impact of malaria chemoprophylaxis on school performance. The results found that children had uneducated fathers were 22.02% and 21.85% (Prophylaxis group and in placebo group respectively), moderate educated fathers were 42.60% and 55.56% (Prophylaxis group and in placebo group respectively), primary educated fathers were 22.74% and 14.44% (Prophylaxis group and in placebo group respectively), junior secondary educated fathers were 12.64% and 8.15%(Prophylaxis group and in placebo group respectively) (34).

Parent's educations

A study assessed impact of an acute malaria infection on school performance in childhood. This study explained that children who had less educated parent had associated with poorer school performance (<0.001) (55).

Parent's used alcohol and smoking

A pervious study found that mother smoking more than 10 cigarettes per day during pregnancy had associated with difficult in reading, spelling and arithmetic.

Makin et al. was conducted a prospective study among children age 6-9 years old. This study assessed the maternal smoking with motor test. The results explained that the maternal smoking had affects to communication and language skills of children (94).

Roeleveld et al. was conducted a retrospective case control study among children age 0-5 years old. This study assessed the mental retardation (IQ <80) with

parent smoking. The result presented that father smoking associated with mental retardation OR= 1.2, 95% CI = (0.8- 1.6) and mother smoking associated with mental retardation OR= 1.1 95% CI= (0.8-1.5) (94).

A previous study assessed the effects of prenatal alcohol expose on school performance. The participants included Caucasian and African –American women at 10 year follow-up. The results showed that the children among mother exposure to alcohol during the first and second trimesters of pregnancy predicted poor overall school performance in reading and spelling score (95).

A retrospective was conducted all 103 children of 30 alcoholic women, the 21 youngest born 1970-76 compared to controls. The result found that prenatal alcohol exposure group had below IQ score than controls (p<0.01) (96).

A previous study assessed prenatal alcohol exposure on school performance among children at 6 years of age. The result presented that prenatal alcohol exposure was significantly related to deficits in reading, spelling, and arithmetic of children (97).

2.4.9 Behavior of children

School absenteeism of children

Previous study assessed malaria infection with poor school performance in an endemic area of the Brazilian Amazon. The results presented that school absenteeism associated with school performance. This study found that school absenteeism throughout the follow-up interval until 1 week Crude Odds Ratio= 0.83, 95% CI= (0.46-1.48), *P*=0.519 and Adjusted Odds ratio= 1.20, 95% CI= (0.65-2.20), *P*= 0.559. The school absenteeism more than 1 malarial attacks during the follow-up more than 1 week Crude Odds Ratio= 2.00, 95% CI= (1.11-3.62), *P*= 0.021 and Adjusted Odds ratio= 1.91, 95% CI= (1.04-3.54), *P*= 0.039. The study explained that children among school absenteeism more than 1 malarial attack was statistically significant associated with poorer school performance (52).

A previous study presented that uncomplicated malaria per socioeconomic status. Malaria was significant associated with loss of school time, illness and poor school performance (13).

2.4.10 Standard of school

In Thailand, The ministry of educations set of regulations rate teacher for students per classroom was 1 teacher per 25 children in a classroom in primary school (57).

2.4.11 Disease to association with school performance

Malaria infection association with school performance

In 2008, the study was conducted in the Municipality of Careiro, Amazonas, Brazil. This study explained that malaria associated with poor school performance. In addition, the study found that 70 (35.4%) among malarial attacks with no case of severe disease. In multivariate analysis, after adjusted for age, mother's education, time living in the study area and school absenteeism, presented that malaria infection predicted a poor performance at school OR = 1.91, 95% CI= (1.04-3.54), p = 0.039. This study explained that malaria attacks were associated with poorer school performance (52).

A prospective study was conducted from January 1998 to November 1999 in a malaria-endemic area of Sri Lanka. This study assessed short-term impact of an acute attack of malaria on the school performance. Three groups were children with malaria, children with non-malarial fever, and healthy control. The study found that the children among malaria group were significantly lower score both in mathematics and language than children with non-malarial fever and healthy control. Two weeks later, the mathematics and language scores of children among malaria group had improved, but the scores still lower than the scores of children with non-malarial fever ($P < 0.001$) and controls ($P < 0.001$). However, malaria infection was significant predictor of school performance after controlling for other confounding factors (55).

A prospective case-control study was conducted in Kampala City, Uganda in 2008. This study assessed on children who had history of malaria with neurological involvement on cognitive ability, behavior and academic achievement. The children among malaria group had lower attention scores OR =0.40, 95% CI = (-0.05, 0.86), *P*= 0.09. The statistically was no significant difference, according to observed in other cognitive abilities or in academic performance (53).

A previous study assessed impact of repeated malarial infections on school performance in children. The study was conducted in children age 6–14 years in a malaria endemic area in southern Sri Lanka. The study assessed to association between the scores of the special test and total number of malarial attacks. The scores of the special test showed that significantly associated with the number of malarial attacks experienced ($P < 0.001$). Language and mathematics scores were poorer in children among malaria infection. In addition, children had experienced more malaria attacks had associated with poorer school performance (51).

A cohort study was conducted in the children age 5 to 12 years at Mulago Hospital,Kampala in Uganda. Participant in the study were children with cerebral malaria (n=44), children with uncomplicated malaria (n=54), and with healthy community children (n=89). The study assessed malaria with cognition performance. The children with cerebral malaria 12.5% with uncomplicated malaria had cognitive deficiency in 1 area, as compared with 7.6% of community children. The deficiencies in children with cerebral malaria were primarily in the area of attention (cerebral malaria, 18.4%, community children, 2.5%). After adjusted for age, gender, nutrition, home environment, and school level, showed that children with cerebral malaria had higher risk 3.67 times to cognitive deficiencies than community children. The study explained that children with malaria infection were related to poor school performance (58).

Kihara et al. assessed everyday memory in three samples of children following recovery from malaria. Three groups were patients with cerebral malaria, patients with malaria plus complex seizures and healthy. This study found that children with cerebral malaria significantly low scores in everyday memory compared with malaria plus seizures and healthy controls ($p = 0.003$) (13).

Carter et al. was conducted a retrospective cohort study among children aged 6-9 years. Children had an episode of cerebral malaria compared with in healthy community. This study found that children with a past history of cerebral malaria significantly impaired function ($p < 0.05$) in speech and language tasks (higher level, language functions, vocabulary, pragmatics, phonology) and cognition (non verbal functioning) (13).

Carter et al. was carried out retrospective to assess the impact of malaria with academic performance in children age 6-9 years. This study found that after 20-112 months cerebral malaria children or children with the past history of malaria was statistically significant impairment to function ($P<0.05$) in subjected to a battery of testing (13).

John et al. conducted a prospective study over two year and assessed long-term cognitive impairment in three groups of children with cerebral malaria (n = 44), uncomplicated malaria (n = 54) and healthy community controls (n = 89). The children with cerebral malaria was significantly associated with impairment of either one or more cognitive domains (compared to uncomplicated malaria group and normal controls) ($p = 0.006$). After adjusted for confounding factors found that a diagnosis of cerebral malaria related to risk of 3.67 times for cognitive impairment compared to healthy children (13).

Birbeck et al. followed up 132 children with retinopathy positive cerebral malaria for a median duration of 495 days (compared to a control group without coma or central nervous system infection). The study found that 90% and 21% of children with cerebral malaria development to epilepsy and neurological deficits (gross motor, sensory and language) (13).

A study assessed the association between malaria with neurocognitive sequelae. This study found that parasitic sequestration and cerebral circulation occurrence to resultant hypoxia, so the malaria infection had affects to immune response and cytokine. Therefore, the results can damage via nitric oxide production may contribute to neuronal cell death (13).

Frenando et al. was carried out a study in 293 children with history acute attack of uncomplicated malaria with school performance. This study suggested that socioeconomic or the school absent due to malaria infection associated with poorer performance (12).

A cohort study in Africa assessed impairment of severe *falciparum* malaria among children. This study found that cerebral malaria and malaria with complicated seizure associated with developmental impairment (59).

Parasitic infection association with school performance

A cross-sectional study was conducted in 210 children among ages 6-11 years old of school children in Brazilian. This study assessed the association between the intensity of helminth infections with poor performance on each of the four cognitive tests. The study found that after adjusting for sex, age, socioeconomic status and other helminth infections including, moderate-to-high-intensity hookworm infection was associated with poor performance on the WISC-III Coding subtest (OR = 3.20; 95% 95%CI = 1.43–7.17), low intensity of hookworm infection associated with poor performance on the WISC-III Coding subtest (odds ratio (OR) = 3.71; 95%CI = 1.80–7.66)and moderate-to-high-intensity *A. lumbricoides* infection was associated with poor performance on the Raven test (OR = 2.03; 95% CI = 1.04–3.99) comparison with uninfected children. In conclusion explained that children co-infected with *A. lumbricoides* infection and hookworm infection had greater odds of poor performance on some WISC-III subtests than children with only *A. lumbricoides* infection. Also presented evidence polyparasitized children experience worse cognitive outcomes than children with only one helminth infection (60).

A cross-sectional study was conducted in 319 children among 7–18 years old in a rural village in Leyte, Philippines. This study found that children with helminths infection including, *Ascaris lumbricoides, Schistosoma japonicum, Necator americanus, and Trichuris trichiura*. This study assessed helminthes infection and cognitive performance. The results presented that *S. japonicum* infection associated with poor performance on tests of learning (odds ratio (OR) = 3.04, 95%CI = 1.1–6.9), *A. lumbricoides* infection associated with poor performance on tests of memory (OR= 2.2, 95%CI = 1.04–4.7), and *T. trichiura infection* associated with poor performance on tests of verbal fluency (OR= 4.5, 95% CI =1.04–30). This study found that helminths infection associated with poor performance in three of the four cognitive domains (50).

The study was carried out double-blind placebo controlled protocol in 159 school children age 9-12 years in Jamaica. This study examined that the effect of moderate to high worm burdens of *Trichuris trichiura* infection on the cognitive functions. However, after removal of worms leaded to a significant improvement in tests of auditory short-term memory ($p < 0.017$; $p < 0.013$), and scanning with

retrieval of long-term memory ($p < 0.001$). In conclusion examined that no longer significantly differences between the children with treated and an uninfected control group in these three tests of cognitive function. In addition, whipworm infection has an adverse effect on certain cognitive functions which is reversible by therapy (61).

Serouri et al. in 2000, was conducted study and examined effects of asymptomatic parasiteaemia with cognitive ability. The study found that no significant differences in cognitive test score between the children with non-parasiteaemic and children remained parasiteaemic, but the finding found impairment of motor skill with parasiteaemia (12).

A case control study was carried out in Yemen in children among parasitaemia. This study was poorer on formal cognitive testing compared with children without parasitaemia (13).

Irion deficiency and anemia

In a previous study examined that the effect of iron deficiency on the brain metabolism, neurotransmitter function and myelin. The iron was an important component of enzyme systems required for DNA synthesis, respiratory chain, neurotransmitter synthesis, and lipid metabolism in the brain. The iron was essential for enzyme involved in the neurotransmitter and found that seventy percent of brain associated with myelin. The iron deficiency was effects to direct on myelin lipid and proteins. Moreover, iron specific damaged in the brain. The study presented that children (6-23 months) with moderate to severe anemia (ID) or chronic anemia (>3 months) lower mental and psychomotor development score than non anemia children (11).

2.5 Factors association with nutritional status

2.5.1 Gender of children

A survey of two poor neighborhoods in Kingston of Jamaica assessed characteristics of children with poorer nutrition status in children 24 month. The risk factors were both male and female (62).

A study assessed effects of *Ascaris* infection of nutritional status and this study examined nutritional status of 30 children. The risk factor included gender matched with the nutritional status (63).

In 2008, a study was conducted in the Municipality of Careiro, Amazonas, Brazil, and assessed the association between malaria with nutritional status in children 5-14 years old. This study explained that the risk factor associated with malnutrition of children and determined gender to the risk factor (52).

2.5.2 Age of children

An epidemiological survey of anthropometric and maturation was carried out at Bogalusa in Louisiana and assessed nutritional status in children. The study was conducted in the children between 5 to 14 years (64).

A longitudinal study assessed malaria infection and nutritional status among male adolescents and adults in the Setting of Intense Perennial Transmission. This study was carried out in children age 10–14 years (65).

A cross sectional study in Western of Kanya assessed malaria infection with nutritional status among per school children. This study conducted in children age 0- 36 month (66).

In a cross-sectional study, was carried out in January 1997 and measured on cognitive performance and nutritional status of 325 schoolchildren in grade1 mostly children age 5-6 years (67).

The school health and nutrition (SHN) of Indonesia was an important to investments for the education since poor health and nutrition among school-age children. Diseases and malnutrition were associated in children to throughout childhood (68).

The study was conducted in the Municipality of Careiro, Amazonas, Brazil and assessed malaria associated with malnutrition status with age 5-14 year-old in children (52).

2.5.3 Weight of children

The study in a rural village in Leyte of Philippines assessed the association between helminthes infection with school performance and nutritional. This study

examined that the independent effects of infection with each of four helminthes. The risk factor was weight and BMI of children (50).

A cross-sectional survey in sub-Saharan Africa was carried out at rural Senegalese preschool children and assessed to impact of childhood malnutrition on the specific anti-*Plasmodium falciparum* antibody response. Malnutrition defined as stunting (height-for-age <-2 z-scores) or wasting (weight-for-height <-2 z-scores) in their study (69).

2.5.4 Hamlet of children

The study in Philippines was carried out in rural village in Leyte and assessed the nutritional status in children (50).

A study was carried out in rural area of Bangladesh. This study assessed to the severe malnutrition in children (70).

2.5.5 Socioeconomic status of children

The study was conducted in an urban African area. This study assessed the relative importance of socioeconomic and maternal/prenatal determinants of the nutritional situation in children age below 6 years old. Effect of socioeconomic factors associated on the nutritional status in children. The main determinant was economic level of the household (P=0.004). In this study presented that economic level associated with nutritional status in children. However lower economic associated with malnutrition status (71).

Health surveys were conducted in 1991 and 1998. This study assessed the association between the explanatory factors and nutritional status. Household economic status had an overall positive effect to increasing under nutrition in children (72).

The article explained effects of several socioeconomic and environmental indicators on the nutritional status (stunting, underweight, and wasting). A sample in study was 802 children aged 12-35.9 months in urban and rural areas of southern Brazil (73).

A prospective nested case-control study assessed respect to the outcome of infected *Plasmodium falciparum* in school children aged 5–14 years from Honiara.

The relationship between nutritional status and resistance to chloroquine treatment, the stratified analysis by logistic regression resulted showed that an eight fold risk of resistance for malnourished children in the higher socio-economic category (OR=8.1, 95%CI= 2.4–27.9, *P*= 0.0001). In children among lower socioeconomic group was no significant associated with malnutrition (OR=1.5, 95%CI=0.4–5.6) (74).

2.5.6 Parent's educations of childhood

In the previous study was conducted in gender inequality and severe malnutrition among children in a remote rural area in Bangladesh. The risk factor to association with malnutrition was education of mothers, so in this study found that severe malnourished children in mothers no education = 35.5%, 1-5 years = 28.3% and more than 6 years =21.6 (70).

2.6 Disease association with nutritional status

Malaria association with nutritional status

In the systematic review assessed effect of *Plasmodium falciparum* on cognition. This study examined whether malaria infections had effect indirect to cognition through nutrition (12).

In 2004, Holding & Kitsao-Wekulo, et al. discussed whether the children with malaria associated with poor nutritional status than healthy children (12).

Bryan et al. 2004, assessed malaria infection in children with nutritional status. This study explained whether malnutrition status associated with poorer cognitive development (12).

A study in Gambia explored the relationship between admission weight and different diseases in total 13579 hospitalized children. However, the study conducted in 7399 children and recruited from several surveys of well subjects to provide anthropometric values for healthy Gambian children. This study compared to the control children and mean admission weights. The results were lower for malaria (weight for age z-score: − 1.602), cerebral malaria (− 1.547), transfused malarial anemia (− 1.764), and malnutrition (− 3.786). (75).

Parasite association with nutritional status

Study in northern, Jakarta assessed effects of intervention methods on nutritional status and cognitive function of primary school in children among age 6-8 years. This study found that 80 percent of children were malnutrition (47).

Kordas et al. in 2004, was conducted the study in Hookworm, *Ascaris lumbricoides* infection and polyparasitism with nutritional status in children. This study examined whether low Hb concentrations among children in poorer resource setting cause to nutrition deficiencies, helminth infections and other disease (60).

CHAPTER III
MATERIALS AND METHODS

The goals of this study were to analyze the association between history of childhood malaria infection with school performance and nutritional status among schoolchildren in primary-secondary school of Tanousri subdistric, Suanphuang district, Ratchaburi province, Thailand. The risk factors were including, characteristics of childhood, socioeconomic status of childhood, behavior of childhood and standard of school.

This study was analyzed confounding factors that associated with school performance and nutritional status. This chapter described the methodology of this study.

3.1 Research Design

A retrospective cohort study was conducted among schoolchildren in primary-secondary school of Tanousri subdistrict, Suanphuang district, Ratchaburi province, Thailand. History of malaria infection was obtained from the medical record of the Rajanagarindra Tropical Diseases Center (RTIC), Suanphung district of Ratchaburi Province, Thailand.

3.2 Research Site

The study was conducted in primary-secondary school of Tanousri subdistrict, Suanphuang district, Ratchaburi province, Thailand. The medical history childhood malaria infection was collected from Rajanagarindra Tropical Diseases Center (RTIC), Suanphung district of Ratchaburi Province, located in western border of Thailand. The center has provided free diagnosis and treatment of malaria in people in this area for more than 15 years. Since the RTIC is the only malaria center in the

area; all malaria cases occurred in the area usually are detected at this center. In this area, there is only one primary-secondary school, almost all local children are studying in this school.

Figure 3.1 Map of Suanphung district, Ratchaburi province, Thailand

3.3 Study population

The children age 6 years old and older who were studying in Rujirapat primary-secondary school of Tanousri subdistrict, Suanphuang district, Ratchaburi province, Thailand.

Study population included students who currently live in the area and had information in the population census recorded by the RTIC. The population was classified into exposed group and non-exposed group according to their history of malaria infection.

Exposed group were students who had history of malaria infection confirmed by history of malaria diagnosis from medical record of Rajanagarindra Tropical Diseases Center (RTIC), Suanphung district of Ratchaburi Province, Thailand.

Non-exposed group were students who were in the population census but had no history of malaria infection in the RTIC medical record.

3.3.1 Inclusion Criteria

- Students in primary (Pratom 1-6) and secondary grades (Matayom 1-3) of the Rujirapat School.
- Currently live in the area of Tanousrisubdistric, Suanphuang district, Ratchaburi province, Thailand.
- Have information in the population census conducted by the RTIC.
- Agree to participate in the study.

3.3.2 Exclusion Criteria

-Student who have meningitis, encephalitis and other central nervous system infections from other cause other than malaria.

- Student who had history of chronic disease (e.g. Heart Disease, Thalassemia, Asthma).

3.4 Study Period

The study period was 1 year and was started after receiving approval from the ethical committee.

3.5 Sample size

PS-power and sample size calculation software program was used to calculated sample size in this study.

The sample size was calculated according to the primary objective of the study, which is to assess association between malaria infection and school performance on cognitive function among schoolchildren, with statistical hypothesis as follows.

Null hypothesis: There is no different in mean math and language scores between exposed and non-exposed group.

Alternative hypothesis: The mean math and language scores between exposed and non-exposed group are not equal.

The variables for calculation obtained from the previous study

- Type I error probability associated with this test of this null hypothesis is 0.05. ($\alpha = 0.05$)

- Probability to reject the null hypothesis that the mean score for exposed and non-exposed groups are equal with (power) 0.8. (Power =0.8)

- Estimated mean math/language score in exposed group (malaria group) is 54 with standard deviation 18 (30).

- Estimated mean math/language score in non-exposed group (non-malaria group) is 60 with standard deviation 20 (30).

- The ratio of exposed and non-exposed groups is 2 (*m*=2).

This study was planed independent non-exposed and exposed with 2 non-exposed (s) per exposed. In a previous study standard deviation of math/language score in non-exposed is 20. If the true difference math/language score in the exposed and non-exposed mean is 6. This study was need 262 to non-exposed and 131exposed to be able to reject the null hypothesis that the population means of the exposed and non-exposed groups are equal with probability (power) 0.8. The Type I error probability associated with this test of this null hypothesis is 0.05.

Thus, the minimum sample sizes were approximately; Exposed groups =131

Non-exposed groups =262

Total = 393

3.6 Tools

1) A questionnaire developed by researcher including, characteristics of children and socioeconomic status of children (gender, age, birth weight, weight, height, hamlet, ethnicity parent's educations, household's income, perinatal history).

2) Cognitive test was assessed by using grade including, test scores of Mathematic, test score of Thai Language and GPA (grade point average) compared with children in the same classroom. Because knowledge and skill of children was through direct including reading, writing and mathematics (30-34).The standardization

was used to z-score in test scores of Mathematic, test score of Thai Language and GPA compared in the same classroom.

-The standardization, using z-score, was assessed by grade of student compared in the same room, because different teacher may have different standard to evaluate grade of children in different classroom. Therefore the standardization of each classroom was helped to avoid bias from different standard of grading of different teachers.

- The standardization was considered to student if who have poor school performance was grade of z-score test below 0.

3) The emotional intelligence test developed by Public Health Ministry of Thailand. The emotional intelligence test has 3 parts including,

Part I: goodness

Part II: acuteness

Part III: Happiness

The score of emotional intelligence test for age 6-11 years old can be divides into 3 groups including,

Score > 50 means the emotional intelligence of children is good

Score 40-49 means the emotional intelligence of children is moderate

Score <40 means the emotional intelligence of children is low (78).

The score of emotional intelligence test for age 12-13 years old can be divides to including,

Normal score of self-control is 13-18

Normal score of sympathetic to others is 16-21

Normal score of responsible is 17-22

Normal score of Motivation is 15-20

Normal score of decisions and solve problems is 14-19

Normal score of relationship is15-20

Normal score of proud of its self is 9-13

Normal score of satisfaction in life is 16-22

Normal score of peace of mind is15-21

* Total score of emotional intelligence can be divides into 3 groups including,

Score > 170 means the emotional intelligence of children is high

Score > 140-170 means the emotional intelligence of children is normal

Score <140 means the emotional intelligence of children is low (79,80).

3.6.4 Nutritional status was assessed following to Public Health Ministry of Thailand. The assessment was used 3 methods including (48).

-Weight for height explained to present of nutritional status including;

Obesity	> +3 SD
Over weight	> + 2 SD to +3 SD
Mal–good nutrition	> 1.5 SD to 2 SD
Normal	1.5 SD to +1.5 SD
Relatively thin	<-1.5 SD to -2 SD
Thin	< -2 SD

-Weight for age explained the relation between growths with age of children and was assessed the protein energy including;

Overweight of standard	>+2 SD
More weight of standard	>+1.5 SD to +2 SD
Normal standard	-1.5 SD to +1.5 SD
Less weight of standard	<-1.5 SD to -2 SD
More less of stand	<-2 SD

- Height for age measured between height within the same age of children and explained past of nutritional status or acute of loss intake protein including;

Over height	>+2 SD
More height	+1.5 SD to +2 SD
Normal	1.5 SD to +1.5 SD
Relatively Stunting	<-1.5 SD to -2 SD
Stunting	<-2 SD

In this study was used 2 methods including weight for age and height for age to conclusions the intensive of nutrition status in children.

3.7. Variables to collection

Variable	Source
• History of childhood malaria infection - Time of malaria infection - Number of malaria attack - Age at first attack - Duration of last attack - Species of malaria infection - Severity of malaria infection	RTIC database
• History of childhood parasite infection	RTIC database
• Grade of childhood - Test score in Mathematic - Test score in Thai Language - GPA (grade point average)	Secondary data from school
• Emotional intelligence	Emotional intelligence test
• Weight of children	Secondary data from school
• Height of children	Secondary data from school
• Perinatal History - Gestational age at birth - Birth weight - ANC history - Complication during birth -Vaccination history	ANC record book
• Gender	Questionnaire
• Age	Questionnaire
• Ethnicity	Questionnaire
• Father’s education	Questionnaire
• Mother’s education	Questionnaire
• Household’s income	Questionnaire
• Alcohol used in mother	Questionnaire

Variable	Source
• Smoking in Mother	Questionnaire
• Smoking in Father	Questionnaire
• School absenteeism of children	Secondary data from school
• Teachers- for-students	Secondary data from school

3.8 Methods of data collection

The data was collected by the following methods

1) The history of malaria infection and parasite infection of the study population were obtained from the RTIC database.

2) The grade of childhood including, test score in Mathematic, test score in Thai Language and GPA (grade point average) were obtained from secondary data of Rujirapat primary-secondary of Tanousri subdistric, Suanphuang district, Ratchaburi, Thailand.

3) The weight and height of students were collected from school.

4) The perinatal history of children (including gestational age at birth, birth weight, ANC history, complication during birth, vaccination history) was collected from the ANC record book of children.

5) Questionnaire was collected by researcher and team. The questionnaire was obtained from interview to students and student's parent.

6) The emotional intelligence test of Public Health Ministry of Thailand was collected by trained teacher for assessment of emotional intelligence for children age 6-11 years old and emotional intelligence test for children age 12-17 years old was collected by self-evaluation of students in Rujirapat primary-secondary school of Tanousri subdistric, Suanphuang district, Ratchaburi, Thailand.

3.9 Process of data collection

1) Researcher was collected secondary data from school and Rajanagarindra Tropical Diseases Center (RTIC); and linked the two databases.

2) Researcher was prepared the questionnaire and emotional intelligence for collection data.

3) Researcher was trained and introduction teacher or team about collection data and fill data before collection data from the children.

4) Informed consent was given to parent of children and assent form was given to children age less than 7 years to less than 13 years old.

5) The perinatal history was collected secondary data from ANC record book of children.

6) Primary data collection, including questionnaire and emotional intelligence test were performed for those who agree to participate in the study.

3.10 Ethical Approval

1) Researcher submitted research proposal to Ethical Review Committee of the Faculty of Tropical Medicine, Mahidol University for approval before conducting the study.

2) The study was approved by the Ethical Review Committee of the Faculty of Tropical Medicine, Mahidol University.

3) The informed consent was obtained from parent of children and assent form was obtained from children age less than 7 years old to less than 13 years old to participation in this study before collection data.

3.11 Data Analysis

All the analysis was calculated using computer statistical package SPSS and the significant association was set at probability value less than 0.05($p<0.05$). P-value was considered to association factors with school performance and nutritional status.

3.11.1 Z-score

Z-score was used to analyze test in Mathematic, test score in Thai Language, and GPA (grade point average) of children in the same classroom.

3.11.2. Descriptive statistics

The data analysis was summarized to frequency, percent, mean and standard deviation. This study was summarized variables including, characteristics of children, socioeconomic of children, malaria infection, parasite infection, behavior of children and standard of school.

3.11.3 Analytic statistics

3.11.3.1 Chi-square test and Fisher exact test was used to analyze to association between factors with school performance and nutritional status.

3.11.3.2 Univariate analysis was used to analyze crude association between factors with school performance and 95% confidence interval.

3.11.3.3 Bivariate analysis was used to analyze association between two variables with school performance and 95% confidence interval.

3.11.3.4 t-test analysis was used to analyze mean factors that association with school performance and 95% confidence interval.

3.11.3.5 Univariate regression was used to determine predicted factors with school performance.

3.11.3.6 Multivariate regression was used to determine predicted factors to association with school performance and nutritional status.

CHAPTER IV
RESULTS

This retrospective cohort study was conducted among primary-secondary schoolchildren in a school of Tanousri subdistrict, Suanphuang district, Ratchaburi province, Thailand. History of malaria infection was obtained from medical record of the Rajanagarindra Tropical Diseases Center (RTIC), Suanphung district of Ratchaburi Province, Thailand. The study was conducted during January 2014 to May 2014. A total of 457 students participated in the study, and classified into malaria group and non malaria group, according to their past history of malaria infection.

This chapter explained the results of the study according to objective of this study. The goal of the study was to determine the association between history of childhood malaria infection and school performance, as well as nutritional status.

4.1General and socioeconomic characteristics of schoolchildren

During the study period, there were total of 1027 students enrolled in the Rujurapat School, 457 students who were permanent residents and had recorded in the population census were asked to participate in the study (Figure 4.1).

Totally 1027 students

457 participated in the study

570 students excluded from study

- not a permanent residents
- without person number ID of RTIC
- missing some variables such as emotional intelligence test, birthday

Malaria 135 cases

Non – malaria 322 cases

The general and socioeconomic characteristics of schoolchildren in Rujirapat School who participated in the study were shown in Table 4.1

A total of schoolchildren of this study was 457 students. Among those, 52%were male and 48%were female. Age of students in the study was divided into two groups. More than half of students (53%) were in age group 6-11 years old, and about 47% were 12-17 years old. The majority of students (82%) were Karen, whereas 18% were Thai. About 60% of students lived in Huay Nam Nak, Pong Haeng, Huay Pak, and Huay Muang village.

According to the perinatal history of students, the majority of students had normal birth weight (≥ 2500 grams) (72%) and had gestational age ≥ 36 weeks (72%) with no complication at birth (4%). About 87% of students reported to have complete vaccination (data from both Antenatal care book and self report). The majority of mothers did not use alcohol during pregnancy (88%).

The majority of fathers and mothers of students were uneducated (60% and 70%) and attended primary school (28% and 21%), respectively. Only one father graduated bachelor degree. The average family income per year of 10,000 to 20,000 Baht and >30,000 Baht was reported in 152 (33%) and 151 (33%) of family, respectively. However, 53% of parents perceived that their household's income was enough. The majority of mothers did not smoke (91%), whereas the majority of fathers (74%) were smoking.

The history of childhood malaria infection was found in 135 students (30%). Among those with past malaria infection, 99 students (73%) had 1-2 malaria attacks; 13 out of 135 students (17%) had malaria attack 5 times or more since birth. Only half of students had recently been tested for intestinal parasitic infection. Among 202 students who had been tested for parasitic infection, 98 of them (49%) had infected with intestinal parasites.

The nutritional status of students showed that 76%, 73%, and 87% of students had normal nutritional status assessed by weight for age, height for age, and weight for height, respectively.

The overall school performance showed that almost half of students had poor score in Thai language, mathematic, and GPA. From the record, the majority of

students (81%) were absent from the school less than 1 week, whereas 19% of them were absent 1 week or more over the semester term.

For the emotional intelligence test, the students had moderate emotional intelligence (43%), low emotional intelligence (39%), and good emotional intelligence (18%) respectively.

For the survey found that rate of teacher per student was about 1 per 40 in each classroom.

Table 4.1 General and socioeconomic characteristics of schoolchildren in Rujirapat School

Variable	Number	Percent (%)
Gender		
Male	237	51.9
Female	220	48.1
Age (years)		
6-11	244	53.4
12-17	213	46.6
Ethnicity		
Karen	374	81.8
Thai	83	18.2
Hamlet		
Huai Nam Nak	83	18.1
Pong Haeng	79	17.3
Huai Pak	57	12.5
Huai Muang	55	12.0
Huai Krawan	42	9.2
Pui Ra Kum	37	8.1
Wang Ko	29	6.3
Nong Ta Dang	28	6.1
Boi Vee	19	4.2
Ta Kean tong	17	3.7
Zi Ngam	11	2.4
Perinatal History		
Birth weight		
<2,500 g	123	28.4
≥ 2,500 g	310	71.6
Gestational		
< 36 weeks	120	27.6
≥36 weeks	315	72.4
Complication		
No had complication	438	95.8
Had complication	19	4.2
Vaccination		
Complete Vaccination	397	86.9
Incomplete Vaccination	60	13.1
Mother used alcohol during pregnancy		
No	402	88.0
Yes	55	12.0
Father's education		
Uneducated	272	59.5
Primary school	128	28.0
High school	51	11.2
Diploma or equivalent	5	1.1
Bachelor degree	1	0.2

Table 4.1 General and socioeconomic characteristics of schoolchildren in Rujirapat School (Cont.)

Variable	Number	Percent (%)
Mother's education		
Uneducated	323	70.7
Primary school	97	21.2
High school	34	7.4
Diploma or equivalent	3	0.7
Bachelor degree	0	0
Average income of family		
Enough	242	53.0
Non-enough	215	47.0
family income per year (Baht)		
<10,000	74	16.2
10,000-20,000	152	33.3
20,001-30,000	80	17.5
>30,000	151	33.0
Father smoking		
Yes	340	74.4
No	117	25.6
Mother smoking		
Yes	40	8.8
No	417	91.2
History of malaria infection		
Non-malaria infected	322	70.5
Malaria infected	135	29.5
Number of Malaria attack (only malaria-infected students; N=135)		
1-2	99	73.3
3-4	23	17.0
≥5	13	9.6
Recent Intestinal Parasitic infection		
Not detected	255	55.8
Detected	202	44.2
Results of Intestinal parasitic infection (only those detected; N=202)		
No infection	104	51.5
Infection	98	48.5
Nutritional status		
Weight for Age		
Normal	349	76.4
Poor nutritional status	108	23.6
Height for Age		
Normal	335	73.3
Poor nutritional status	122	26.7
Weight for Height		
Normal	399	87.3
Poor nutritional status	58	12.7

Table 4.1 General and socioeconomic characteristics of schoolchildren in Rujirapat School (Cont.)

Variable	Number	Percent (%)
School Performance		
Thai Language score		
Poor	220	48.1
Good	207	45.3
Missing	30	6.6
Mathematic score		
Poor	211	46.2
Good	217	47.5
Missing	29	6.3
GPA		
Poor	193	42.2
Good	230	50.3
Missing	34	7.4
School absenteeism (during a semester term)		
< 1 week	372	81.4
≥1 week	85	18.6
Emotional intelligence		
Good	82	17.9
Moderate	195	42.7
Low	180	39.4

A history of childhood malaria infection was recorded in 135 students (30%), all of whom had uncomplicated malaria. The majority of malaria cases were infected with either *Plasmodium falciparum* or *Plasmodium vivax*. Only two students were infected with *Plasmodiummalariae.*Among these children, 99 (73%) had experienced 1–2 malaria attacks and 13 (17%) had had 5 or more malaria attacks since birth. Almost half of the malaria-infected students (45%) had their first malaria infection during the first 4 years of life. Recent infection (within <1 year) was observed in only 4 students. For the majority of malaria-infected students (80%) it had been 3 years or more since their last malaria infection (Table 4.2).

Table 4.2 Pattern of malaria infection among malaria-infected students

Variable	Number	Percent (%)
Total	135	
Type of malaria infection		
Plasmodium falciparum (PF)	50	37.0
Plasmodium vivax (PV)	45	33.4
Plasmodium malariae (PM)	1	0.7
Mixed infection (PF&PV)	5	3.7
PF+PV*	33	24.5
PM+PV*	1	0.7
No. of malaria attacks		
1–2	99	73.3
3–4	23	17.0
≥5	13	9.6
Age at first malaria infection (years)		
0–4	61	45.2
>4	74	54.8
Duration since last malaria attack (years)		
<1	4	3.0
1–2	19	14.1
3–4	33	24.4
≥5	79	58.5

*** Multiple episodes**

Mean in Thai language score of Thai students and Karen students were 76.1 and 73.7 respectively (figure 4.2). Mean in Mathematic score of Thai students and Karen student were 71.7 and 70.9 respectively (figure 4.3). However, Karen students had lower mean score both in Thai language and mathematic than Thai students.

Figure 4.2 Scatter plot Thai language score by ethnicity

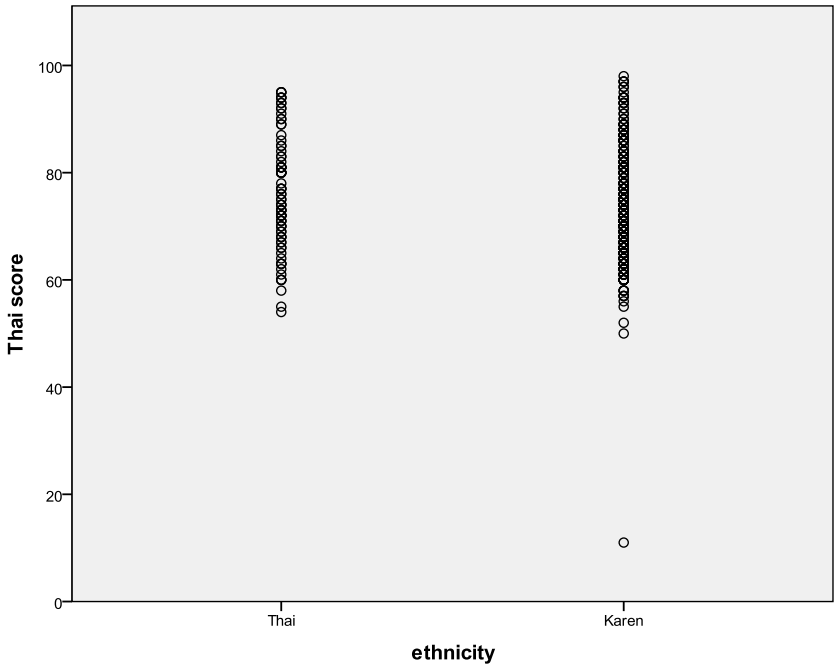
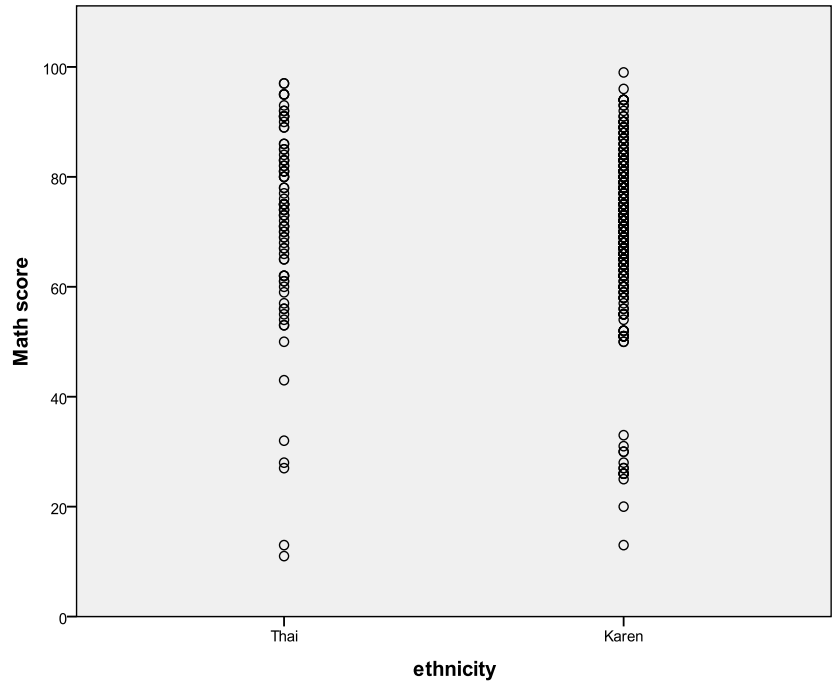


Figure 4.3 Scatter plot Mathematic score by ethnicity



4.2 Comparison mean different between groups

Students who had past history of malaria infection had lower mean of mathematic and Thai language score than those without history of malaria infection. However, only difference in mathematic score showed statistically significant difference between malaria group and non malaria group (mean difference =3.91, p=0.01). The mean score of emotional intelligence test showed that no statistically significant difference between malaria group and non malaria group (Table 4.3).

Table 4.3 T-test estimated mean differences between malaria and non malaria groups

Variable	Malaria group M(SD) (N=135)	Non- Malaria group M(SD) (N=322)	Mean difference (SD)	P
School performance				
Mathematic score	68.2(16.1)	72.1(13.7)	3.91	0.01
Thai language score	73.2(8.31)	74.5(10.9)	1.31	0.19
Emotional intelligence				
6-11 years	54.4(29.5)	49.7(20.5)	-4.73	0.29
12-17 years	140.0(11.0)	141.1(11.1)	1.10	0.48

Students who had past history of more malaria attack had lower mean of mathematic and Thai language score than those without history of malaria infection. However, both difference in mathematic score and Thai language score showed statistically significant difference to number of malaria attack ($p = 0.001$ and $p = 0.04$ respectively).Which, both of mean in mathematic score and Thai language score decreased with increasing number of malaria attack. The mean score of emotional intelligence test showed that no statistically significant difference to number of malaria attack (Table 4.4).

Table 4.4 Mean and Standard deviation of school performance and emotional intelligence by number of malaria attack

Variable	Number of malaria attack				P
	0 (N=322)	1-2 (N=99)	3-4 (N=23)	5+ (N=13)	
School performance					
Mathematic score	72.1(13.7)	70.0(12.9)	65.5(20.6)	57.6(26.7)	0.001*
Thai Language score	74.5(10.9)	73.7(8.37)	73.0(8.32)	69.2(7.37)	0.04*
Emotional intelligence					
6-11 years	49.7(20.5)	53.2(28.4)	68.4(41.8)	39.4(0)	0.14
12-17 years	141.1(11.1)	141.7(11.3)	136.6(8.54)	137.8(11.7)	0.27

Students who had duration since last malaria infection more than 1 year had lower mean score of mathematic score and Thai language score compared with those since last malaria infection less than 1 year. The mean score of mathematic score and Thai Language score showed that no statistically significant difference with duration since last malaria infection ($p = 0.72$ and $p=0.84$ respectively). However, the mean score of emotional intelligence test presented that no statistically significant difference with duration since last malaria infection (Table 4.5).

Table 4.5 Mean and Standard deviation of school performance and emotional intelligence by duration since last malaria infection

Variable	Duration since last malaria infection(years)				P
	<1 (N=4)	1-2 (N=19)	3-4 (N=33)	5+ (N=79)	
School performance					
Mathematic score	76.5(8.8)	69.6(13.8)	67.3 (15.7)	67.7(17.2)	0.72
Thai Language score	73.5(10.1)	72.2(6.8)	72.5(9.45)	73.8(8.26)	0.84
Emotional intelligence					
6-11 years	48.7(6.7)	42.0(7.5)	65.8(40.3)	52.4(27.0)	0.32
12-17 years	147.0(0)	142.5(7.8)	140.7(11.3)	139.1(11.5)	0.69

4.3 The association between independent and dependent variables univariate analysis

4.3.1 Demographic characteristics by malaria group and non malaria group

The results of this study presented that factors including, gender, ethnicity, age group, parent education, and family income per year significantly associated with childhood malaria infection (Table 4.6). The majority of malaria cases 61% were male, while 39% were female. Male children had 1.67 times (OR= 1.67, 95%CI= 1.11–2.51) greater chance of having malaria infection in the past than female children. Students who were Karen had 4.82 times (OR= 4.82, 95%CI = 2.25–10.3) higher risk to past malaria infection than students who were Thai. Approximately 62% of student in malaria group were aged 12-17 years old, whereas only 40% of students in non-malaria group were aged 12-17 years. Students who had history of malaria infection were about three times more likely to have uneducated fathers or mothers. The students from low income family (less than 30,000 Baht) had higher chance to have childhood malaria infection than those from high income family (more than 30,000 baht) (OR= 3.21, 95% CI= 1.95 – 5.30). This represents some kinds of risk factors to malaria.

Table 4.6 Demographic characteristics of students in malaria and non-malaria groups

Variable	Malaria group (N=135)	Non- Malaria group (N=322)	Crude Odds Ratio	P
Gender				0.014*
Female	53(39.3)	167(51.9)	1.00	
Male	82(60.7)	155(48.1)	1.67(1.11 – 2.51)	
Ethnicity				<0.001*
Thai	8(5.9)	75(23.3)	1.00	
Karen	127(94.1)	247(76.7)	4.82(2.25 – 10.3)	
Age (year)				<0.001*
6 -11 years	51(37.8)	193(59.9)	1.00	
12 – 17 years	84(62.2)	129(40.1)	2.46(1.63 – 3.73)	
Father's education				<0.001*
Educated	30(22.2)	155(48.1)	1.00	
Uneducated	105(77.8)	167(51.9)	3.25(2.05 – 5.15)	
Mother's education				<0.001*
Educated	21(15.6)	113(35.1)	1.00	
Uneducated	114(84.4)	209(64.9)	2.94(1.75 – 4.93)	
Family income				0.76
Enough	70(51.9)	172(53.4)	1.00	
Non-enough	65(48.1)	150(46.6)	1.06(0.71 – 1.59)	
Family income per year				<0.001*
≥ 30,000 Baht	23(17.0)	128(39.8)	1.00	
< 30,000 Baht	112(83.0)	194(60.2)	3.21(1.95 – 5.30)	

4.3.2 The association between malaria infection and school performance

The school performance was classified into poor or good according to the distribution of test score. Students who had test score less than the standard z score of each class would be classified as having poor school performance. Students who had past history of malaria infection had 1.42 times higher risk to poor mathematic score than those without history of malaria infection (OR=1.42, 95%CI = 0.92 – 2.19). The risk of poor mathematic increased with increasing number of malaria attack. Students who had past history of more number of malaria attacks had higher risk to poor mathematic score than those without history of malaria attack. However, these differences were not statistically significant (Table 4.7).

Table 4.7 The association between malaria infection and school performance in test score of mathematic

Variable	School performance in test score of mathematic		Crude Odds Ratio	P
	Poor (N=211)	No poor (N=217)		
Malaria infected				0.11
Non malaria infected	148(47.0)	167(53.0)	1.00	
Malaria infected	63(55.8)	50(44.2)	1.42(0.92 – 2.19)	
Malaria attack				
None attack	148(47.0)	167(53.0)	1.00	0.25
1-2	45(52.3)	41(47.7)	1.24(0.77 – 2.00)	0.38
3-4	11(64.7)	6(35.3)	2.07(0.75 – 5.73)	0.16
≥5	7(70.0)	3(30.0)	2.63(0.67 – 10.4)	0.17

*Poor school performance was grade of z-score test below 0 in the same classroom

Among those who had past history of malaria infection, 55% had poor test score in Thai language, as compared with 50% of those without malaria infection who had poor test score. Students who had past history of malaria infection had 1.23 times higher risk to poor Thai language score than those without history of malaria infection (OR =1.23, 95%CI= 0.80 – 1.90). The risk of poor Thai language score also increased with increasing number of attack. However, these differences were not statistically significant (Table 4.8).

Table 4.8 The association between malaria infection and school performance in test score of Thai language

Variable	School performance in test score of Thai language		Crude Odds Ratio	P
	Poor (N=220)	No poor (N=207)		
Malaria infected				0.35
Non malaria infected	158(50.2)	157(49.8)	1.00	
Malaria infected	62(55.4)	50(44.6)	1.23(0.80 – 1.90)	
Malaria attack				
None	158(50.2)	157(49.8)	1.00	0.58
1-2	45(52.9)	40(47.1)	1.12(0.69 – 1.81)	0.65
3-4	10(58.8)	7(41.2)	1.42(0.53 – 3.82)	0.49
≥5	7(70.0)	3(30.0)	2.32 (0.59 – 9.13)	0.23

*Poor school performance was grade of z-score test below 0 in the same classroom

Approximately 55 % of students who had past history of malaria infection had poor grade point average (GPA). Students who had past history of malaria infection had 1.70 times significantly higher risk to poor GPA than those without history of malaria infection. The risk of poor GPA increased with increasing number of malaria attack; although the increasing trend was not statistically significant (Table 4.9).

Table 4.9 The association between malaria infection and school performance in GPA

Variable	School performance in GPA (grade point average for semester term)		Crude Odds Ratio	P
	Poor (N=193)	No poor (N=230)		
Malaria infected				0.02*
Non malaria infected	131(42.1)	180(57.9)	1.00	
Malaria infected	62(55.4)	50(44.6)	1.70(1.10 – 2.63)	
Malaria attack				
None	131(42.1)	180(57.9)	1.00	0.08
1-2	45(52.9)	40(47.1)	1.55(0.95 – 2.50)	0.76
3-4	10(58.8)	7(41.2)	1.96(0.73 – 5.29)	0.18
≥5	7(70.0)	3(30.0)	3.21(0.81 -12.6)	0.10

*Poor school performance was grade of z-score test below 0 in the same classroom

4.3.3 The association between malaria infection and emotional intelligence

About 45% of students who had past history of malaria infection were low emotional intelligence. Only 37% of students without history of malaria infection were normal emotional intelligence. The result of study showed that there was no statistically significant associated between malaria infection and emotional intelligence (Table 4.10).

Table 4.10 The association between malaria infection and emotional intelligence

Variable	Low EQ (N=180)	Normal EQ (N=277)	Crude Odds Ratio	P
Emotional intelligence				
Non malaria infected	119(37.0)	203(63.0)	1.00	0.10
Malaria infected	61(45.2)	74(54.8)	1.41(0.94 – 2.11)	
Malaria attack				
None	203(63.0)	119(37.0)	1.00	0.17
1-2	58(58.6)	41(41.4)	0.37(0.12 – 1.15)	0.84
3-4	11(47.8)	12(52.2)	0.44(0.13 – 1.45)	0.18
≥5	227(60.6)	180(39.4)	0.68(0.17 – 2.72)	0.59

4.3.4 The association between malaria infection and nutritional status

Only one fourth of students with and without past history of malaria infection had poor nutritional status indicated by weight for age (23% and 24% respectively) and by height for age (31% and 25% respectively). The study showed that no statistically significant associated between childhood malaria infection and nutritional status (Table 4.11 – 4.12).

Table 4.11 The association between malaria infection and nutritional status (weight for age)

Variable	Weight for age		Crude Odds Ratio	P
	Poor (N=108)	Non poor (N=349)		
Malaria infected				0.83
Non malaria infected	77(23.9)	245(76.1)	1.00	
Malaria infected	31(23.0)	104(77.0)	0.95(0.59 – 1.53)	
Malaria attack				
None	245(76.1)	77(23.9)	1.00	0.86
1-2	78(78.8)	21(21.2)	0.71(0.21 – 2.36)	0.57
3-4	17(73.9)	6(26.1)	0.61(0.17 – 2.16)	0.44
≥5	9(69.2)	4(30.8)	0.79(0.18 – 3.56)	0.76

Table 4.12 The association between malaria infection and nutritional status (height for age)

Variable	Height for age		Crude Odds Ratio	P
	Poor (N=122)	Non poor (N=335)		
Malaria infected				0.17
Non malaria infected	80(24.8)	242(75.2)	1.00	
Malaria infected	42(31.1)	93(68.9)	1.37(0.88 – 2.13)	
Malaria attack				
None	242(75.2)	80(24.8)	1.00	0.28
1-2	71(71.7)	28(28.3)	0.39(0.13 – 1.18)	0.09
3-4	15(65.2)	8(34.8)	0.46(0.14 – 1.49)	0.19
≥5	7(53.8)	6(46.2)	0.62(0.15 – 2.49)	0.78

4.3.5 The others factors associated with school performance in test score of Mathematic

Beside malaria infection, other factors that significantly associated with poor mathematic score included gender, parent education, annual family income, school absenteeism, and emotional intelligence (Table 4.13).

The majority of poor mathematic score was male. Therefore, male had 2.87 times higher risk of poor mathematic score than female (OR = 2.87, 95%CI = 1.94 – 4.25).

About 53% of students who had uneducated fathers and mothers had poor mathematic score, whereas only 40% of students with educated parents had poor score. The risk of poor mathematic score among students who had uneducated fathers was 1.43 times higher than those who had educated fathers (OR = 1.43, 95%CI = 0.97 – 2.11). Moreover, the risk of poor mathematic score among students who had uneducated mothers was 1.64 times higher than those who had educated mothers (OR = 1.64, 95%CI =1.08 – 2.49).

More than half of students from low income family (< 30,000 Baht per year) had poor mathematic score. Students from low income family had higher risk to poor mathematic score 1.86 times than those from high income family (OR = 1.86, 95%CI = 1.24 – 2.79).

In the record of school, the majority of students who had school absenteeism more than 1 week over a semester (66%) had poor mathematic score. However, students who had school absenteeism more than 1 week had higher risk to poor mathematic score 2.29 times than those school absenteeism less than 1 week over a semester term (OR = 2.29, 95%CI = 1.33 – 3.94).

Approximately 65% of students who had low emotional intelligence had poor mathematic score. Students among low emotional intelligence had higher risk to poor mathematic score than those normal emotional intelligence (OR = 2.74, 95%CI = 1.83 – 4.12).

The factors that were not significantly associated with poor mathematic score included ethnicity, age, mother used alcohol during pregnancy, father smoking, mother smoking, birth weight, gestational age, complication, vaccination, parasite infection, and nutritional status (table 4.13).

Table 4.13 The association between others factors with school performance in test score of mathematic

Variable	School performance in test score of mathematic		Crude OR	P
	Poor (N=211)	No poor (N=217)		
Gender				<0.001*
Female	76(36.2)	134(63.8)	1.00	
Male	135(61.9)	83(38.1)	2.87(1.94 – 4.25)	
Ethnicity				0.47
Thai	37(45.7)	44(54.3)	1.00	
Karen	174(50.1)	173(49.9)	1.20(0.74 – 1.94)	
Age (year)				0.13
6 – 11 years	126(52.5)	114(47.5)	1.00	
12 -17 years	85(42.2)	103(54.8)	0.75(0.51 – 1.09)	
Father's education				0.07
Educated	78(44.1)	99(55.9)	1.00	
Uneducated	133(53.0)	118(47.0)	1.43(0.97 – 2.11)	
Mother's education				0.02*
Educated	53(40.8)	77(59.2)	1.00	
Uneducated	158(53.0)	140(47.0)	1.64(1.08 – 2.49)	
Family income per year				0.003*
≥30,000 baht	59(39.3)	91(60.7)	1.00	
<30,000 baht	152(54.7)	126(45.3)	1.86(1.24 – 2.79)	
Mother used alcohol during pregnancy				0.85
Used alcohol	25(48.1)	27(51.9)	1.00	
Non used alcohol	186(49.5)	190(50.5)	1.06(0.59 – 1.89)	
Father smoking				0.79
Non smoking	54(48.2)	58(51.8)	1.00	
Smoking	157(49.7)	159(50.3)	1.06(0.69 – 1.63)	
Mother smoking				0.81
Smoking	19(47.5)	21(52.5)	1.00	
Non smoking	192(49.5)	196(50.5)	1.08(0.56 – 2.08)	
Birth weight				0.79
<2,500 g	56(48.7)	59(51.3)	1.00	
≥2,500 g	145(50.2)	144(49.8)	1.06(0.69 – 1.63)	
Gestational				0.15
≥ 36 weeks	141(47.3)	157(52.7)	1.00	
< 36 weeks	61(55.5)	49(44.5)	1.39(0.89 – 2.15)	
Complication				0.52
Had complication	8(42.1)	11(57.9)	1.00	
No had complication	203(49.6)	206(50.4)	1.35(0.53 – 3.44)	
Vaccination				0.41
Full Vaccination	181(48.5)	192(51.5)	1.00	
Non full Vaccination	30(54.5)	25(45.5)	1.27(0.72 – 2.25)	
Parasite infection				0.94
Infected	45(47.9)	49(52.1)	1.00	
None	47(48.5)	50(51.5)	1.02(0.58 – 1.81)	
School absenteeism				0.003*
≤ 1 week	166(46.1)	194(53.9)	1.00	
≥1 week	45(66.2)	23(33.8)	2.29(1.33 – 3.94)	

*Poor school performance was grade of z-score test below 0 in the same classroom

Table 4.13 The association between others factors with school performance in test score of mathematic (Cont.)

Variable	School performance in test score of mathematic		Crude OR	P
	Poor (N=211)	No poor (N=217)		
Emotional intelligence				<0.001*
Normal	108(40.1)	161(59.9)	1.00	
Low	103(64.8)	56(35.2)	2.74(1.83 – 4.12)	
Nutritional status				
Weight For Age				0.38
Poor nutritional status	45(45.5)	54(54.5)	1.00	
Non poor nutritional status	166(50.5)	163(49.5)	1.22(0.78 – 1.92)	
Height For Age				0.48
Poor nutritional status	52(46.4)	60(53.6)	1.00	
Non poor nutritional status	159(50.3)	157(49.7)	1.17(0.76 – 1.80)	
Weight For Height				0.80
Non poor nutritional status	182(49.1)	189(50.9)	1.00	
Poor nutritional status	29(50.9)	28(49.1)	1.08(0.62 – 1.88)	

*Poor school performance was grade of z-score test below 0 in the same classroom

4.3.6 The others factors associated with school performance in test score of Thai Language

The factors that were significantly associated with poor Thai language score included gender, mother's education, school absenteeism, and emotional intelligence (Table 4.14).

About 68% of male had poor Thai language score, as compared with only 34% of female students who had poor Thai language score. Male had higher risk to poor Thai language score than female (OR= 4.11, 95%CI = 2.75 – 6.16).

Approximately 55% of students who had uneducated fathers and mothers had poor Thai language score. The risk of poor Thai language score among students who had uneducated mothers was 1.56 times higher than those who had educated mothers. (OR = 1.56, 95%CI = 1.03 – 2.36). The risk of poor Thai language score among students who had uneducated fathers was 1.37 times higher than those who had educated fathers (OR = 1.37, 95%CI = 0.93 – 2.02). However, father's education was not significantly associated with poor Thai language score.

Students who had school absenteeism more than 1 week over a semester had higher risk to poor Thai language score 2.06 times than those who absent from the school less than 1 week (OR = 2.06, 95% CI = 1.19 – 3.54).

About 70% of students who had low emotional intelligence had poor Thai language score, as compared with only 40% of student with normal emotional intelligence that had poor language score. Low emotional intelligence increase the risk of poor Thai language score by 3.31 times, as compare with normal emotional intelligence (OR =3.31, 95%CI = 2.18 – 5.03).

The factors that were not significantly associated with poor Thai language included age, ethnicity, father's education, family income per year, mother used alcohol during pregnancy, father smoking, mother smoking, birth weight, gestational age, complication, vaccination, parasite infection, and nutritional status (table 4.14).

Table 4.14 The association between others factors with school performance in test score of Thai Language

Variable	School performance in test score of Thai language score		Crude OR	P
	Poor (N=220)	No poor (N=207)		
Gender				<0.001*
Female	72(34.3)	138(65.7)	1.00	
Male	148(68.2)	69(31.8)	4.11(2.75 – 6.16)	
Ethnicity				0.10
Thai	35(43.2)	46(56.8)	1.00	
Karen	185(53.5)	161(46.5)	1.51(0.93 – 2.46)	
Age				0.98
6 – 11 years	123(51.5)	116(48.5)	1.00	
12 – 17 years	97(51.6)	91(48.4)	1.01(0.69 – 1.47)	
Father's education				0.10
Educated	83(46.9)	94(53.1)	1.00	
Uneducated	137 (54.8)	113(45.2)	1.37(0.93 – 2.02)	
Mother's education				0.04*
Educated	57(43.8)	73(56.2)	1.00	
Uneducated	163(54.9)	134(45.1)	1.56(1.03 – 2.36)	
Family income per year				0.14
≥ 30,000 baht	70(46.7)	80(53.3)	1.00	
< 30,000 baht	150(54.2)	127(45.8)	1.35(0.91 – 2.01)	
Mother used alcohol during pregnancy				0.21
Non used alcohol	189(50.4)	186(49.6)	1.00	
Used alcohol	31(59.6)	21(40.4)	1.45(0.81 – 2.62)	
Father smoking				0.95
Smoking	162(51.4)	153(48.6)	1.00	
Non smoking	58(51.8)	54(48.2)	1.01(0.67 – 1.56)	
Mother smoking				0.97
Smoking	20(51.3)	19(48.7)	1.00	
Non smoking	200(51.5)	188(48.5)	1.01(0.52– 1.95)	
Birth weight				0.48
≥ 2,500 g	146(50.5)	143(49.5)	1.00	
< 2,500 g	62(54.4)	52(45.6)	1.17(0.76 – 1.80)	
Gestational				0.27
≥ 36 weeks	149(50.2)	148(49.8)	1.00	
< 36 weeks	62(56.4)	48(43.6)	1.28(0.83 – 1.99)	
Complication				0.92
No had complication	210(51.5)	198(48.5)	1.00	
Had complication	10(52.6)	9(47.4)	1.05(0.42 – 2.63)	
Vaccination				0.73
Full Vaccination	191(51.2)	182(48.8)	1.00	
Non full Vaccination	29(53.7)	25(46.3)	1.11(0.62 – 1.96)	
Parasite infection				0.73
Infected	50(53.2)	44(46.8)	1.00	
None	54(55.7)	43(44.3)	1.11(0.63 – 1.95)	
School absenteeism				0.009*
≤ 1 week	175(48.7)	184(51.3)	1.00	
≥1 week	45(66.2)	23(33.8)	2.06(1.19 – 3.54)	

*Poor school performance was grade of z-score test below 0 in the same classroom

Table 4.14 The association between others factors with school performance in test score of Thai Language (Cont.)

Variable	School performance in test score of Thai language score		Crude OR	P
	Poor (N=220)	No poor (N=207)		
Emotional intelligence				<0.001*
Normal	110(40.9)	159(59.1)	1.00	
Low	110(69.6)	48(30.4)	3.31(2.18 – 5.03)	
Nutritional status				
Weight For Age				0.65
Non poor nutritional status	167(50.9)	161(49.1)	1.00	
Poor nutritional status	53(53.5)	46(46.5)	1.11(0.71- 1.74)	
Height For Age				0.61
Non poor nutritional status	160(50.8)	155(49.2)	1.00	
Poor nutritional status	60(53.6)	52(46.4)	1.12(0.73 – 1.72)	
Weight For Height				0.92
Poor nutritional status	29(50.9)	28(49.1)	1.00	
Non poor nutritional status	191(51.6)	179(48.4)	1.03(0.59 – 1.80)	

*Poor school performance was grade of z-score test below 0 in the same classroom

4.3.7 The others factors associated with school performance in test score of grade point average for semester term (GPA)

The factors that were significantly associated with poor mathematic score included gender, ethnicity, mother's education, family income per year, gestational age, school absenteeism, and emotional intelligence (Table 4.15).

Male students had higher risk to poor GPA than female students (OR= 3.67, 95%CI = 2.45 - 5.50). About 60% of male students had poor GPA, as compare with only 30% female students who had poor GPA.

Approximately 48% and 35% of Karen and Thai students had poor Thai language, respectively. The risk of poor GPA among students who were Karen was 1.68 times higher than students who were Thai (OR = 1.68, 95%CI = 1.01 – 2.79).

About 49% of students who had uneducated mothers had poor GPA, while only 36% of those who had educated mothers had poor GPA. The risk of poor GPA among students who had uneducated mothers was 1.89 times higher than those who had educated mothers (OR = 1.89, 95%CI = 1.25 – 2.85).

Low family income was also associated with poor GPA. Students from low income family (< 30,000 baht per year) had higher risk of poor GPA 1.89 times than those from high income family (≥ 30,000 Baht per year) (OR = 1.89, 96%CI = 1.25 – 2.85).

Poor GPA was found in 55% and 42% of students who were pre-term and term delivery, respectively. Students who were born at gestational age < 36 weeks had higher risk of having poor GPA than those who were born at gestational age ≥ 36 weeks (OR= 1.63, 95%CI = 1.05 – 2.54).

The risk of poor GPA among students who had school absenteeism more than 1 week over a semester was 3.38 times higher than those school absenteeism less than 1 week (OR = 3.38, 95%CI = 1.92 – 5.94).

The majority of students who had low emotional intelligence (64%) had poor GPA, as compared with only 35% of those with normal emotional intelligence who had poor GPA. Students with low emotional intelligence had higher risk to poor GPA than those with normal emotional intelligence (OR = 3.27, 95%CI = 2.17 – 4.94).

The factors that were not significantly associated with poor school performance in GPA included age, father education, mother used alcohol during pregnancy, father smoking, mother smoking, birth weight, complication, vaccination, parasite infection, and nutritional status (Table 4.15).

Table 4.15 The association between others factors with school performance in grade point average for semester term (GPA)

Variable	School performance in GPA		Crude Odds Ratio	P-value
	Poor (N=193)	No poor (N=230)		
Gender				<0.001*
Female	62(29.8)	146(70.2)	1.00	
Male	131(60.9)	84(39.1)	3.67(2.45 - 5.50)	
Ethnicity				0.04*
Thai	28(35.4)	51(64.6)	1.00	
Karen	165(48.0)	179(52.0)	1.68(1.01 – 2.79)	
Age(year)				0.78
12 – 17 years	83(44.9)	102(55.1)	1.00	
6 – 11 years	110(46.2)	128(53.8)	1.06(0.72 – 1.55)	
Father's education				0.17
Educated	73(41.7)	102(58.3)	1.00	
Uneducated	120(48.4)	128(51.6)	1.31(0.89 – 1.93)	
Mother's education				0.02*
Educated	48(36.9)	82(63.1)	1.00	
Uneducated	145(49.5)	148(50.5)	1.67(1.10 – 2.56)	
Family income per year				0.002*
≥ 30,000 baht	53(35.6)	96(64.4)	1.00	
< 30,000 baht	140(51.1)	134(48.9)	1.89(1.25 – 2.85)	
Mother used alcohol during pregnancy				0.34
Non used alcohol	167(44.8)	206(55.2)	1.00	
Used alcohol	26(52.0)	24(48.0)	1.34(0.74 – 2.41)	
Father smoking				0.81
Non smoking	50(44.6)	62(55.4)	1.00	
Smoking	143(46.0)	168(54.0)	1.05(0.68 – 1.63)	
Mother smoking				0.84
Non smoking	176(45.5)	211(54.5)	1.00	
Smoking	17(47.2)	19(52.8)	1.07(0.54 – 2.13)	
Birth weight				0.73
< 2,500 g	50(44.2)	63(55.8)	1.00	
≥ 2,500 g	132(46.2)	154(53.8)	1.08(0.70 – 1.67)	
Gestational				0.03*
≥ 36 weeks	124(42.3)	169(57.7)	1.00	
< 36 weeks	60(54.5)	50(45.5)	1.63(1.05 – 2.54)	
Complication				0.88
No had complication	184(45.5)	220(54.5)	1.00	
Had complication	9(47.4)	10(52.6)	1.08(0.43 – 2.70)	
Vaccination				0.06
Full Vaccination	162(43.9)	207(56.1)	1.00	
Non full Vaccination	31(57.4)	23(42.6)	1.72(0.97 – 3.07)	
Parasite infection				0.90
None	46(47.4)	51(52.6)	1.00	
Infected	44(48.4)	47(51.6)	1.04(0.58 – 1.84)	
School absenteeism				<0.001*
≤ 1 week	146(41.0)	210(59.0)	1.00	
≥1 week	47(70.1)	20(29.9)	3.38(1.92 – 5.94)	

*Poor school performance was grade of z-score test below 0 in the same classroom

Table 4.15 The association between others factors with school performance in grade point average for semester term (GPA) (Cont.)

Variable	School performance in GPA		Crude Odds Ratio	P-value
	Poor (N=193)	No poor (N=230)		
Emotional intelligence				<0.001*
Normal	94(35.1)	174(64.9)	1.00	
Low	99(63.9)	56(36.1)	3.27(2.17 – 4.94)	
Nutritional status				
Weight For Age				0.95
Poor nutritional status	44(45.4)	53(54.6)	1.00	
Non poor nutritional status	149(45.7)	177(54.3)	1.01(0.64 – 1.60)	
Height For Age				0.89
Poor nutritional status	50(45.0)	61(55.0)	1.00	
Non poor nutritional status	143(45.8)	169(54.2)	1.03(0.67 – 1.59)	
Weight For Height				0.48
Non poor nutritional status	165(45.0)	202(55.0)	1.00	
Poor nutritional status	28(50.0)	28(50.0)	1.22(0.70 – 2.15)	

*Poor school performance was grade of z-score test below 0 in the same classroom

4.3.8 The others factors associated with nutritional status (weight for age)

The factors that were significantly associated with poor nutrition status indicated by weight for age included gender, mother used alcohol during pregnancy, and birth weight (Table 4.16).

Approximately 28% of males students had poor nutritional status, compared with only 19% of females students who had poor nutritional status. Male had about 1.72 times higher risk to poor nutritional status indicated by weight for age than female (OR = 1.72, 95% CI = 1.11 – 2.68).

Poor nutritional status was found in 36% and 22% of students who had mothers used alcohol during pregnancy and did not use alcohol respectively. Students who had mother use alcohol during pregnancy had 2.04 times (OR =2.04, 95%CI = 1.12 – 3.71) higher risk to poor nutritional status than those who had mother did not use alcohol.

The poor nutritional status was found in 32% of students who had birth weight < 2,500 grams while it was found in only 21% among students with birth weight

≥ 2,500 grams. Students with low birth weight (< 2,500 grams) had higher risk to poor nutritional status than those birth weight ≥2,500 grams (OR = 1.78 95% CI = 1.12 – 2.85).

The factors that were not significantly associated with poor nutritional status included ethnicity, age, parent education, family income per year, father smoking, mother smoking, gestational age, complication, vaccination, parasite infection, school absenteeism, emotional intelligence, and school performance (Thai language, Mathematic, and GPA) (Table 4.16).

Table 4.16 The association between others factors with nutritional status (weight for age)

Variable	Nutritional status		Crude Odds Ratio	P-value
	Poor (N=108)	Non poor (N=349)		
Gender				0.02*
Female	41(18.6)	179(81.4)	1.00	
Male	67(28.3)	170(71.1)	1.72(1.11 – 2.68)	
Ethnicity				0.11
Thai	14(16.9)	69(83.1)	1.00	
Karen	94(25.1)	280(74.9)	1.65(0.89 – 3.08)	
Age(year)				0.16
12 – 17 years	44(20.7)	169(79.3)	1.00	
6 – 11 years	64(26.2)	180(73.8)	1.37(0.88 – 2.12)	
Father's education				0.20
Educated	38(20.5)	147(79.5)	1.00	
Uneducated	70(25.7)	202(24.3)	1.34(0.86 – 2.10)	
Mother's education				0.69
Educated	30(22.4)	104(77.6)	1.00	
Uneducated	78(24.1)	245(75.9)	1.10(0.68 – 1.78)	
Family income				0.63
Enough	55(22.7)	187(77.3)	1.00	
Non-enough	53(24.7)	162(75.3)	1.11(0.72 – 1.71)	
Family income per year				0.39
≥ 30,000 baht	32(21.2)	119(78.8)	1.00	
< 30,000 baht	76(24.8)	230(75.2)	1.23(0.77 – 1.96)	
Mother used alcohol during pregnancy				0.02*
Non used alcohol	88(21.9)	314(78.1)	1.00	
Used alcohol	20(36.4)	35(63.6)	2.04(1.12 – 3.71)	
Father smoking				0.68
Non smoking	26(22.2)	91(77.8)	1.00	
Smoking	82(24.1)	258(75.9)	1.11(0.67 -2.84)	
Mother smoking				0.32
Non smoking	96(23.0)	321(77.0)	1.00	
Smoking	12(30.0)	28(70.0)	1.43(0.70 – 2.93)	
Birth weight				0.02*
≥ 2,500 g	64(20.6)	246(79.4)	1.00	
< 2,500 g	39(31.7)	84(68.3)	1.78(1.12 – 2.85)	
Gestational				0.62
< 36 weeks	27(22.5)	93(77.5)	1.00	
≥ 36 weeks	78(24.8)	237(75.2)	1.13(0.69 – 1.87)	
Complication				0.42
Had complication	3(15.8)	16(84.2)	1.00	
No had complication	105(24.0)	333(76.0)	1.68(0.48 – 5.88)	
Vaccination				0.95
Non full Vaccination	14(23.3)	46(76.7)	1.00	
Full Vaccination	94(23.7)	303(76.3)	1.02(0.54 – 1.94)	
Parasite infection				0.57
None	24(23.1)	80(76.9)	1.00	
Infected	26(26.5)	72(73.5)	1.20(0.63 – 2.28)	
School absenteeism				0.41
≤ 1 week	85(22.8)	287(77.2)	1.00	
≥1 week	23(27.1)	62(72.9)	1.25(0.73 – 2.14)	

Table 4.16 The association between others factors with nutritional status (weight for age) (Cont.)

Variable	Nutritional status		Crude Odds Ratio	P-value
	Poor (N=108)	Non poor (N=349)		
Emotional intelligence				0.92
Normal	65(23.5)	212(76.5)	1.00	
Low	43(23.9)	137(76.1)	1.02(0.66 – 1.59)	
School performance				
No Poor Thai Language	46(22.2)	161(77.8)	1.00	0.65
Poor Thai Language	53(24.1)	167(75.9)	1.11(0.71 – 1.74)	
Poor Mathematic	45(21.3)	166(78.7)	1.00	0.38
No poor Mathematic	54(24.9)	163(75.1)	1.22(0.78 – 1.92)	

4.3.9 The others factors to association with nutritional status (height for age)

The factors were significantly associated with poor nutritional status by height for age including, ethnicity, parent education, family income per year, mother used, alcohol during pregnancy, and school absenteeism (Table 4.17).

Approximately 30% and 10% of Karen and Thai students had poor nutritional status, respectively. However, the risk of poor nutritional status among students who were Karen was 3.56 times higher than those who were Thai. (OR = 3.56, 95%CI = 1.72 – 7.36).

About 31% and 29% of students who had uneducated fathers and mothers had poor nutritional status, respectively, while 20% of students who had educated parents had poor nutritional status. The risk of poor nutritional status among students who had uneducated fathers was 1.82 times higher than those who had educated fathers (OR = 1.82, 95%CI = 1.17 – 2.83). Moreover, the risk of poor nutritional status among students who had uneducated mothers was 1.65 times higher than those who had educated mother (OR = 1.65, 95% CI = 1.02 – 2.68).

The poor nutritional status was found in 31% of students from low income family (< 30,000 Baht per year) while it was found in only 18% among students from high income family (≥ 30,000 Baht per year). Students from low income family had higher risk to poor nutritional status than those from high income family (OR = 2.07, 95%CI = 1.28 – 3.35).

Poor nutritional status was found in 42% and 25% of students who had mother used alcohol during pregnancy and did not use alcohol respectively. Students who had mother use alcohol during pregnancy had 2.20 times (OR = 2.20, 95%CI = 1.23 – 3.94) higher risk to poor nutritional status than those who had mother did not use alcohol.

The factors that were not significantly associated with poor nutritional status included gender, age, father smoking ,mother smoking, birth weight, gestational age, complication, vaccination, parasite infection, school absenteeism, emotional intelligence, and all school performance (Table 4.17).

Table 4.17 The association between others factors with nutritional status (height for age)

Variable	Nutritional status		Crude Odds Ratio	P-value
	Poor (N=122)	Non poor (N=335)		
Gender				0.32
Female	54(24.5)	166(75.5)	1.00	
Male	68(28.7)	169(71.3)	1.24(0.82 – 1.88)	
Ethnicity				0.001*
Thai	9(10.8)	74(89.2)	1.00	
Karen	113(30.2)	261(69.8)	3.56(1.72 – 7.36)	
Age(year)				0.81
6 – 11 years	64(26.2)	180(73.8)	1.00	
12 – 17 years	58(27.2)	155(72.2)	1.05(0.70 – 1.59)	
Father's education				0.008*
Educated	37(20.0)	148(80.0)	1.00	
Uneducated	85(31.3)	187(68.8)	1.82(1.17 – 2.83)	
Mother's education				0.04*
Educated	27(20.1)	107(79.9)	1.00	
Uneducated	95(29.4)	228(70.6)	1.65(1.02 – 2.68)	
Family income				0.93
Non-enough	57(26.5)	158(73.5)	1.00	
Enough	65(26.9)	177(73.1)	1.02(0.67 - 1.54)	
Family income per year				0.003*
≥ 30,000 baht	27(17.9)	124(82.1)	1.00	
< 30,000 baht	95(31.0)	211(69.0)	2.07(1.28 – 3.35)	
Mother used alcohol during pregnancy				0.008*
Non used alcohol	99(24.6)	303(75.4)	1.00	
Used alcohol	23(41.8)	32(58.2)	2.20(1.23 – 3.94)	
Father smoking				0.13
Non smoking	25(21.4)	92(78.6)	1.00	
Smoking	97(28.5)	243(71.5)	1.45(0.89 – 2.42)	
Mother smoking				0.62
Non smoking	110(26.4)	307(73.6)	1.00	
Smoking	12(30.0)	28(70.0)	1.20(0.59 – 2.43)	
Birth weight				0.19
≥ 2,500 g	77(24.8)	233(75.2)	1.00	
< 2,500 g	38(30.9)	85(69.1)	1.35(0.85 – 2.15)	
Gestational				0.43
≥ 36 weeks	80(25.4)	235(74.6)	1.00	
< 36 weeks	35(29.2)	85(70.8)	1.21(0.76 – 1.93)	
Complication				0.97
Had complication	5(26.3)	14(73.7)	1.00	
No had complication	117(26.7)	321(73.3)	1.02(0.36 – 2.90)	
Vaccination				0.54
Full Vaccination	104(26.2)	293(73.8)	1.00	
Non full Vaccination	18(30.0)	42(70.0)	1.21(0.67 – 2.19)	
Parasite infection				0.85
Infected	28(28.6)	70(71.4)	1.00	
None	31(29.8)	73(70.2)	1.06(0.58 – 1.95)	

Table 4.17 The association between others factors with nutritional status (height for age) (Cont.)

Variable	Nutritional status		Crude Odds Ratio	P-value
	Poor (N=122)	Non poor (N=335)		
School absenteeism				0.05
≤ 1 week	92(24.7)	280(75.3)	1.00	
≥1 week	30(35.3)	55(64.7)	1.66(1.00 – 2.75)	
Emotional intelligence				0.99
Low	48(26.7)	132(73.3)	1.00	
Normal	74(26.7)	203(73.3)	1.00(0.66 – 1.53)	
School performance				
No Poor Thai Language	52(25.1)	155(74.9)	1.00	
Poor Thai Language	60(27.3)	160(72.7)	1.12(0.73 – 1.72)	0.61
Poor Mathematic	52(24.6)	159(75.4)	1.00	0.48
No poor Mathematic	60(27.6)	157(72.4)	1.17(0.76 – 1.80)	

4.4 Multivariate Analysis

The multivariate analysis evaluated the potential confounder and the effect of factors that influenced school performance (Mathematic score, Thai language score, grade point average for semester term) and nutritional status.

Potential confounders were considered from variables that were significantly associated with school performance and nutritional status from univariate analysis and from review of literature. These selected variables were included in the multivariate models.

4.4.1 The association between malaria infection and school performance by multivariate analysis

From the univariate analysis, students who had past history of malaria infection had 1.42 times higher risk to poor mathematic score than those without history of malaria infection (OR=1.42, 95%CI = 0.92 – 2.19, p=0.11). The risk of poor mathematic decreased after controlling gender, age, father education, mother education, family income per year, school absenteeism, and emotional intelligence. However, students who had past history of malaria infection still higher risk than those without history of malaria infection (adjusted OR =1.16, 95%CI =0.70 –1.90) (Table 4.18).

Table 4.18 Association between malaria infection and school performance in test score of Mathematic by Multiple Logistic Regression Analysis

Variable	School performance in test score of mathematic		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=211)	No poor (N=217)				
Malaria infected				0.11		0.56
Non malaria infected	148(47.0)	167(53.0)	1.00		1.00	
Malaria infected	63(55.8)	50(44.2)	1.42(0.92 – 2.19)		1.16(0.70 –1.90)	

*Poor school performance was grade of z-score test below 0 in the same classroom

From the crude odd ratio, students who had past history of malaria infection had 1.23 times higher risk to poor Thai language score than those without history of malaria infection (OR =1.23, 95%CI= 0.80 – 1.90, p=0.35). The risk of poor Thai language score decreased after adjusting for gender, age, ethnicity, father education, mother education, school absenteeism and emotional intelligence. Students who had past history of malaria infection had no risk to poor Thai language score after controlling potential factors (adjusted OR = 0.93, 95%CI = 0.56 –1.55) (Table 4.19).

Table 4.19 Association between malaria infection and school performance in test score of Thai Language by Multiple Logistic Regression Analysis

Variable	School performance in test score of Thai language		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=220)	No poor (N=207)				
Malaria infected				0.35		0.79
Non malaria infected	158(50.2)	157(49.8)	1.00		1.00	
Malaria infected	62(55.4)	50(44.6)	1.23(0.80 – 1.90)		0.93(0.56 –1.55)	

*Poor school performance was grade of z-score test below 0 in the same classroom

The risk of poor GPA among students who had history of malaria infection was 1.70 times higher than those without history of malaria infection (OR = 1.70, 95%CI = 1.10 – 2.63). The risk of poor GPA among students who had past history of malaria infection was 1.17 times higher than those without history of malaria infection (adjusted OR =1.17, 95%CI = 0.68 – 2.03). However, the risk of poor GPA decreased after controlling for gender, age, ethnicity, mother education, family income per year, gestational age, vaccination, school absenteeism, and emotional intelligence (Table 4.20).

Table 4.20 Association between malaria infection and school performance in GPA by Multiple Logistic Regression Analysis

Variable	School performance in GPA		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=193)	No poor (N=230)				
Malaria infected				0.02*		0.56
Non malaria infected	131(42.1)	180(57.9)	1.00		1.00	
Malaria infected	62(55.4)	50(44.6)	1.70(1.10 – 2.63)		1.17(0.68 – 2.03)	

*Poor school performance was grade of z-score test below 0 in the same classroom

4.4.2 The association between malaria infection and nutritional status by multivariate analysis

Both of univariate and multivariate analysis found that no significant associated between malaria infection and nutritional status . The results show that, malaria had no risk to poor nutritional status by weight for age after adjusted for gender, age, mother used alcohol during pregnancy and birth weight (Table 4.21).

Table 4.21 Association between malaria infection and nutritional status (weight for age) by Multiple Logistic Regression Analysis

Variable	Weight for Age		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=108)	Non poor (N=349)				
Malaria infected				0.83		0.68
Malaria infected	31(23.0)	104(77.0)	1.00		1.00	
Non malaria infected	77(23.9)	245(76.1)	1.05(0.66 – 1.70)		1.11(0.66 – 1.87)	

Students who had history of malaria infection had higher risk to poor nutritional status by height for age 1.37 times than students who had no history of malaria infection (OR = 1.37, 95%CI = 0.88 – 2.13). Whereas the results of multivariate analysis showed that, malaria had no risk to poor nutritional status after controlling for ethnicity, age, father education, mother education, family income, mother used alcohol during pregnancy, school absenteeism (adjusted OR = 0.98, 95%CI = 0.60 – 1.59) (table 4.22).

Table 4.22 Association between malaria infection and nutritional status (height for age) by Multiple Logistic Regression Analysis

Variable	Height for Age		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=122)	Non poor (N=335)				
Malaria infected				0.17		0.93
Non malaria infected	80(24.8)	242(75.2)	1.00		1.00	
Malaria infected	42(31.1)	93(68.9)	1.37(0.88 – 2.13)		0.98(0.60 – 1.59)	

4.4.3. The association between factors and school performance in test score of mathematic by multivariate analysis

The factors demonstrated significantly to risk of poor mathematic score included gender, age, father education, mother education, family income per year, malaria infection, school absenteeism, and emotional intelligence. According to Multiple Logistic Regression of each risk was controlling for the effect of other factors. It was found that (Table 4.23)

Gender: In the multivariate analysis, male still had higher risk to poor mathematic score than female (adjusted OR = 2.58, 95%CI = 1.69 – 3.93). The odd ratio decreased after controlling potential factors.

Age: In the multivariate analysis, students among age 6-11 years had higher risk to poor mathematic score than those among age 12-17 years (adjusted OR =1.82, 95% CI = 1.17 – 2.84).

Parent education: The risk of poor mathematic score among students who had uneducated fathers was 1.43 times higher than those who had educated fathers (OR = 1.43, 95%CI = 0.97 – 2.11). But in the multivariate analysis, students who had uneducated father had no risk to poor mathematic score than those who had educated father. While the risk of poor mathematic score among students who had uneducated mothers was 1.13 times higher than those who had educated mothers (adjusted OR = 1.13, 95%CI = 0.62 – 2.03). The odd ratio decreased after controlling confounding factors.

Family income per year: Students from low income family (< 30,000 baht) had higher risk to poor mathematic score was 1.80 times than those from high income family (≥30,000 Baht) (adjusted OR = 1.80, 95%CI = 1.11 – 2.91). The odd ratio of poor mathematic score decreased after controlling other factors.

School absenteeism: Students who had school absenteeism more than 1 week had higher risk to poor mathematic score 2.36 times than those school absenteeism less than 1 week (adjusted OR = 2.36, 95%CI = 1.30 – 4.28). The odd ratio of poor mathematic score increased after controlling for confounding factors.

Emotional intelligence: Students among low emotional intelligence had higher risk to poor mathematic score 3.03 times than those normal emotional

intelligence (adjusted OR= 3.03, 95%CI =1.92 – 4.78). However, the risk increased after controlling others factors.

Table 4.23 Association between factors and school performance in test score of Mathematic by Multiple Logistic Regression Analysis

Variable	School performance in test score of mathematic		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=211)	No poor (N=217)				
Gender				<0.001*		<0.001*
Female	76(36.2)	134(63.8)	1.00		1.00	
Male	135(61.9)	83(38.1)	2.87(1.94 – 4.25)		2.58(1.69 – 3.93)	
Age (year)				0.13		0.008*
12 -17 years	85(42.2)	103(54.8)	1.00		1.00	
6 – 11 years	126(52.5)	114(47.5)	1.34(0.91 – 1.96)		1.82(1.17 – 2.84)	
Father's education				0.07*		0.98
Educated	78(44.1)	99(55.9)	1.00		1.00	
Uneducated	133(53.0)	118(47.0)	1.43(0.97 – 2.11)		0.99(0.58 – 1.69)	
Mother's education				0.02*		0.69
Educated	53(40.8)	77(59.2)	1.00		1.00	
Uneducated	158(53.0)	140(47.0)	1.64(1.08 – 2.49)		1.13(0.62 – 2.03)	
Family income per year				0.003*		0.02*
≥30,000 baht	59(39.3)	91(60.7)	1.00		1.00	
<30,000 baht	152(54.7)	126(45.3)	1.86(1.24 – 2.79)		1.80(1.11 – 2.91)	
Malaria infected				0.11		0.56
Non malaria infected	148(47.0)	167(53.0)	1.00		1.00	
Malaria infected	63(55.8)	50(44.2)	1.42(0.92 – 2.19)		1.16(0.70 – 1.90)	
School absenteeism				0.003*		0.005*
≤ 1 week	166(46.1)	194(53.9)	1.00		1.00	
≥1 week	45(66.2)	23(33.8)	2.29(1.33 – 3.94)		2.36(1.30 – 4.28)	
Emotional intelligence				<0.001*		<0.001*
Normal	108(40.1)	161(59.9)	1.00		1.00	
Low	103(64.8)	56(35.2)	2.74(1.83 – 4.12)		3.03(1.92 – 4.78)	

*Poor school performance was grade of z-score test below 0 in the same classroom

The factors demonstrated significantly to risk of poor mathematic score at 10 percentile cut-off included gender, school absenteeism, and emotional intelligence. These factors were similar in z-score test that below zero but age and family income showed difference. Multiple Logistic Regression of each risk was controlling for the effect of other factors. It was found that (Table 4.24)

Gender: Male had higher risk to poor mathematic score than female after controlling for confounding factors. (adjusted OR = 3.56, 95%CI =1.61 – 7.87).

School absenteeism: The risk of poor mathematic score among students who had school absenteeism more than 1 week was 2.49 times higher than those school absenteeism less than 1 week (adjusted OR =2.49, 95%CI = 1.15 – 5.36).

Emotional intelligence: Students among low emotional intelligence had higher risk to poor mathematic score 3.03 times than those normal emotional intelligence after controlling confounding factors (adjusted OR = 3.14, 95%CI = 1.57 – 6.30).

Table 4.24 Association between factors and school performance in test score of Mathematic (10 percentile cut-off) by Multiple Logistic Regression Analysis

Variable	School performance in test score of mathematic		Adjusted Odd Ratio	P
	Poor (N=44)	No poor (N=384)		
Gender				0.002*
Female	9(4.3)	201(95.7)	1.00	
Male	35(16.1)	183(83.9)	3.56(1.61 – 7.87)	
Age (year)				0.40
12 -17 years	19(10.1)	169(89.9)	1.00	
6 – 11 years	25(10.4)	215(89.6)	1.35(0.67 - 2.70)	
Father's education				0.53
Educated	17(9.6)	160(90.4)	1.00	
Uneducated	27(10.8)	224(89.2)	0.77(0.34 – 1.75)	
Mother's education				0.74
Educated	10(7.7)	120(92.3)	1.00	
Uneducated	34(11.4)	264(88.6)	1.17(0.45 – 3.09)	
Family income per year				0.35
≥30,000 baht	12(8.0)	138(92.0)	1.00	
<30,000 baht	32(11.5)	246(88.5)	1.46(0.66 –3.22)	
Malaria infected				0.77
Non malaria infected	31(9.8)	284(90.2)	1.00	
Malaria infected	13(11.5)	100(88.5)	0.89(0.41 – 1.93)	
School absenteeism				0.02*
≤ 1 week	31(8.6)	329(91.4)	1.00	
≥1 week	13(19.1)	55(80.9)	2.49(1.15 – 5.36)	
Emotional intelligence				0.001*
Normal	16(5.9)	253(94.1)	1.00	
Low	28(17.6)	131(82.4)	3.14(1.57 – 6.30)	

*Poor school performance was grade of 10 percentile cut-off in the same classroom

4.4.4 The association between factors and school performance in test score of Thai language by multivariate analysis

The factors demonstrated significantly to risk of poor mathematic score included gender, ethnicity, age, father education, mother education, malaria infection, school absenteeism, and emotional intelligence. According to Multiple Logistic Regression of each risk was controlling for the effect of other factors. It was found that (Table 4.25),

Gender: After controlling factors, male had higher risk to poor Thai language score than female (adjusted OR =3.75, 95%CI = 2.45 – 5.75).

Parent education: The risk of poor Thai language score among students who had uneducated fathers was 1.37 times higher than those who had educated fathers (OR = 1.37, 95%CI = 0.93 – 2.02). In the multivariate analysis, students who had uneducated fathers had no risk to poor mathematic score than those who had educated fathers. However, the risk of poor Thai language score among students who had uneducated mothers was 1.14 times higher than those who had educated mothers (adjusted OR = 1.14, 95%CI =0.63 – 2.06). The odd ratio decreased after controlling confounding factors.

School absenteeism: In multivariate analysis, students who had school absenteeism more than 1 week had higher risk to poor Thai language score 2.36 times than those school absenteeism less than 1 week (adjusted OR = 2.36, 95%CI = 1.28 – 4.37). The odd ratio increased after controlling for confounding factors.

Emotional intelligence: Students among low emotional intelligence had higher risk to poor Thai language score 3.39 times than those normal emotional intelligence (adjusted OR =3.39, 95%CI = 2.13 – 5.39). After controlling other factors, the risk increased to poor Thai language score.

Table 4.25 Association between factors and school performance in test score of Thai language by Multiple Logistic Regression Analysis

Variable	School performance in test score of Thai language		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=220)	No poor (N=207)				
Gender				<0.001*		<0.001*
Female	72(34.3)	138(65.7)	1.00		1.00	
Male	148(68.2)	69(31.8)	4.11(2.75 – 6.16)		3.75(2.45 – 5.75)	
Ethnicity				0.10*		0.27
Thai	35(43.2)	46(56.8)	1.00		1.00	
Karen	185(53.5)	161(46.5)	1.51(0.93 – 2.46)		1.29(0.82 – 2.01)	
Age				0.98		0.18
6 – 11 years	123(51.5)	116(48.5)	1.00		1.54(0.82 – 2.89)	
12 – 17 years	97(51.6)	91(48.4)	1.01(0.69 – 1.47)		1.00	
Father's education				0.10*		0.87
Educated	83(46.9)	94(53.1)	1.00		1.00	
Uneducated	137 (54.8)	113(45.2)	1.37(0.93 – 2.02)		0.95(0.54 – 1.67)	
Mother's education				0.04*		0.66
Educated	57(43.8)	73(56.2)	1.00		1.00	
Uneducated	163(54.9)	134(45.1)	1.56(1.03 – 2.36)		1.14(0.63 – 2.06)	
Malaria infected				0.35		0.79
Non malaria infected	158(50.2)	157(49.8)	1.00		1.00	
Malaria infected	62(55.4)	50(44.6)	1.23(0.80 – 1.90)		0.93(0.56 – 1.55)	
School absenteeism				0.009*		<0.006*
≤ 1 week	175(48.7)	184(51.3)	1.00		1.00	
≥1 week	45(66.2)	23(33.8)	2.06(1.19 – 3.54)		2.36(1.28 – 4.37)	
Emotional intelligence				<0.001*		<0.001*
Normal	110(40.9)	159(59.1)	1.00		1.00	
Low	110(69.6)	48(30.4)	3.31(2.18 – 5.03)		3.39(2.13 – 5.39)	

*Poor school performance was grade of z-score test below 0 in the same classroom

The factors demonstrated significantly to risk of poor Thai Language score at 10 percentile cut-off included gender, school absenteeism, and emotional intelligence. These factors were similar in z-score test that below zero. According to Multiple Logistic Regression of each risk was controlling for the effect of other factors. It was found that (Table 4.26)

Gender: Male had higher risk to poor Thai language score than female after controlling for confounding factors (adjusted OR = 4.19, 95% CI = 1.65 – 10.7).

School absenteeism: Students who had school absenteeism more than 1 week had higher risk to poor Thai language score 2.91 times than those school absenteeism less than 1 week after controlling confounding factors (adjusted OR = 2.91, 1.27 – 6.63).

Emotional intelligence: Students among low emotional intelligence had higher risk to poor Thai language score 2.72 times than those normal emotional intelligence (adjusted OR =2.72, 95%CI = 1.25 – 5.91).

Table 4.26 Association between factors and school performance in test score of Thai Language (10 percentile cut-off) by Multiple Logistic Regression Analysis

Variable	School performance in test score of Thai language		Adjusted Odd Ratio	P
	Poor (N=35)	No poor (N=392)		
Gender				0.003*
Female	6(2.9)	204(97.1)	1.00	
Male	29(13.4)	188(86.6)	4.19(1.65 – 10.7)	
Ethnicity				0.20
Thai	9(11.1)	72(88.9)	1.00	
Karen	26(7.5)	320(92.5)	0.54(0.21 – 1.40)	
Age				0.89
12 – 17 years	17(9.0)	171(91.0)	1.00	
6 – 11 years	18(7.5)	221(92.5)	1.05(0.49 – 2.26)	
Father's education				0.54
Educated	12(6.8)	165(93.2)	1.00	
Uneducated	23(9.2)	227(90.8)	1.36(0.49 – 3.74)	
Mother's education				0.77
Educated	9(6.9)	121(93.1)	1.00	
Uneducated	26(8.8)	271(91.2)	0.85(0.29 – 2.48)	
Malaria infected				0.76
Non malaria infected	23(7.3)	292(92.7)	1.00	
Malaria infected	12(10.7)	100(89.3)	1.14(0.49 – 2.62)	
School absenteeism				0.01*
≤ 1 week	23(6.4)	336(93.6)	1.00	
≥1 week	12(17.6)	56(82.4)	2.91(1.27 – 6.63)	
Emotional intelligence				0.01*
Normal	13(4.8)	136(86.1)	1.00	
Low	22(13.9)	256(95.2)	2.72(1.25 – 5.91)	

* Poor school performance was grade of 10 percentile cut-off in the same classroom

4.4.5 The association between factors and school performance in grade point average for semester term by multivariate analysis

The factors demonstrated significantly to risk of GPA were including, gender, ethnicity, mother education, family income per year, gestational age, malaria infection, school absenteeism, and emotional intelligence. According to Multiple Logistic Regression of each risk was controlling for the effect of other factors. It was found that (Table 4.27),

Gender: In multivariate analysis, male had higher risk to poor GPA than female (adjusted OR =4.04, 95% CI = 2.53 – 6.45). However, the risk of poor GPA increased after controlling other factors.

Age: Students among age 12-17 years had higher risk to poor GPA than students among 6-11 year (adjusted OR =1.53, 95%CI = 0.93 – 2.50).

Ethnicity: The risk of poor GPA among students who were Karen was 1.56 times higher than those who were Thai (adjusted OR =1.59, 95%CI = 0.81 – 3.11). The risk of poor GPA increased after controlling confounding factors.

Mother education: In the crude odd ratio, students who had uneducated mothers had higher risk to poor GPA than those who had educated mothers. While in adjusted odd ratio, students who had uneducated mothers had no risk to poor GPA than those who had educated mothers.

Family income per year: Students from low income family (<30,000 baht) had higher risk to poor GPA 1.75 times than those from high income family (≥30,000 Baht) (adjusted OR = 1.73, 95%CI = 1.03 – 2.93). The odd ratio decreased to poor GPA after controlling confounding factors.

Gestational age: Students among gestational age < 36 weeks had higher risk to poor GPA than those among gestational age ≥ 36 weeks (adjusted OR= 1.69, 95%CI = 0.99 – 2.89). However, the risk increased to poor GPA after controlling confounding factors.

School absenteeism: The risk of poor GPA among students who had school absenteeism more than 1 week was 3.63 times higher than those school absenteeism less than 1 week (adjusted OR =3.75, 95%CI = 1.92 – 7.31). The odd ratio increased to poor GPA after controlling confounding factors.

Emotional intelligence: Students among low emotional intelligence had higher risk to poor GPA than those normal emotional intelligence (adjusted OR =3.57, 95%CI = 2.18 – 5.84). However, the risk of poor GPA increased after controlling for confounding factors.

Table 4.27 Association between factors and school performance in GPA by Multiple Logistic Regression Analysis

Variable	School performance in GPA		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=193)	No poor (N=230)				
Gender				<0.001*		<0.001*
Female	62(29.8)	146(70.2)	1.00		1.00	
Male	131(60.9)	84(39.1)	3.67(2.45 - 5.50)		4.04(2.53 – 6.45)	
Age(year)				0.78		0.09
12 – 17 years	83(44.9)	102(55.1)	1.00		1.00	
6 – 11 years	110(46.2)	128(53.8)	1.06(0.72 – 1.55)		1.53(0.93 – 2.50)	
Ethnicity				0.04*		0.17
Thai	28(35.4)	51(64.6)	1.00		1.00	
Karen	165(48.0)	179(52.0)	1.68(1.01 – 2.79)		1.59(0.81 – 3.11)	
Mother's education				0.02*		0.88
Educated	48(36.9)	82(63.1)	1.00		1.00	
Uneducated	145(49.5)	148(50.5)	1.67(1.10 – 2.56)		0.96(0.54 – 1.69)	
Family income per year				0.002*		0.04*
≥ 30,000 baht	53(35.6)	96(64.4)	1.00		1.00	
< 30,000 baht	140(51.1)	134(48.9)	1.89(1.25 – 2.85)		1.73(1.03 – 2.93)	
Gestational				0.03*		0.05
≥ 36 weeks	124(42.3)	169(57.7)	1.00		1.00	
< 36 weeks	60(54.5)	50(45.5)	1.63(1.05 – 2.54)		1.26(0.99 – 2.89)	
Malaria infected				0.02*		0.40
Non malaria infected	131(42.1)	180(57.9)	1.00		1.00	
Malaria infected	62(55.4)	50(44.6)	1.70(1.10 – 2.63)		1.26(0.73 – 2.16)	
School absenteeism				<0.001*		<0.001*
≤ 1 week	146(41.0)	210(59.0)	1.00		1.00	
≥1 week	47(70.1)	20(29.9)	3.38(1.92 – 5.94)		3.75(1.92 – 7.31)	
Emotional intelligence				<0.001*		<0.001*
Normal	94(35.1)	174(64.9)	1.00		1.00	
Low	99(63.9)	56(36.1)	3.27(2.17 – 4.94)		3.57(2.18 – 5.84)	

4.4.6 The association between factors and nutritional status by multivariate analysis

The factors that demonstrated significantly to risk of poor nutritional status by weight for age were including, gender, mother used alcohol during pregnancy, and birth weight, and malaria infection. According to Multiple Logistic Regression of each risk was controlling for the effect of other factors. It was found that (Table 4.28),

Gender: Male had higher risk to poor nutritional status by weight for age than female (adjusted OR = 1.75, 95%CI = 1.10 – 2.80).

Age: Students among age 6-11 years had higher risk to poor nutritional status by weight for age than students among age 12-17 years (adjusted OR = 1.46, 95%CI =0.91 – 2.35).

Mother used alcohol during pregnancy: Students who had mother used alcohol during pregnancy had higher risk to poor nutritional status 1.93 times than those who had mother did not use alcohol during pregnancy (adjusted OR =1.98, 95%CI = 1.05 – 3.73). The risk of poor nutritional status decreased after controlling confounding factors.

Birth weight: Students among birth < 2,500 grams had higher risk to poor nutritional status than those birth weight ≥ 2,500 grams (adjusted OR = 1.79, 95%CI =1.10 –2.90). The odd ratio increased to poor nutritional status after controlling other factors.

Table 4.28 Association between factors and nutritional status (weight for age) by Multiple Logistic Regression Analysis

Variable	Nutritional status by weight for age		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=108)	Non poor (N=349)				
Gender				0.02*		0.02*
Female	41(18.6)	179(81.4)	1.00		1.00	
Male	67(28.3)	170(71.1)	1.72(1.11 – 2.68)		1.75(1.10 – 2.80)	
Age(year)				0.16		0.11
12 – 17 years	44(20.7)	169(79.3)	1.00		1.00	
6 – 11 years	64(26.2)	180(73.8)	1.37(0.88 – 2.12)		1.46(0.91 – 2.35)	
Mother used alcohol during pregnancy				0.02*		0.03*
Non used alcohol	88(21.9)	314(78.1)	1.00		1.00	
Used alcohol	20(36.4)	35(63.6)	2.04(1.12 – 3.71)		1.98(1.05 – 3.73)	
Birth weight				0.02*		0.02*
≥ 2,500 g	64(20.6)	246(79.4)	1.00		1.00	
< 2,500 g	39(31.7)	84(68.3)	1.78(1.12 – 2.85)		1.79(1.10 –2.90)	
Malaria infected				0.83		0.68
Malaria infected	31(23.0)	104(77.0)	1.00		1.00	
Non malaria infected	77(23.9)	245(76.1)	1.05(0.66 – 1.70)		1.11(0.66 – 1.87)	

The factors that demonstrated significantly to risk of poor nutritional status by height for age were including, ethnicity, age, father education, mother education, family income per year, mother used alcohol during pregnancy, malaria infection According to Multiple Logistic Regression of each risk was controlling for the effect of other factors. It was found that (Table 4.29),

Ethnicity: The risk of poor nutritional status by height for age among students who were Karen was 2.78 times higher than those who were Thai (adjusted OR = 2.78, 95%CI = 1.25 – 6.20). The risk of poor nutritional status decreased after controlling for confounding factors.

Age: Students among age 6-11 years had higher risk to poor nutritional status than students among 12-17 years (adjusted OR = 1.10, 95%CI = 0.70 – 1.70).

Parent education: The risk of poor nutritional status among students who had uneducated fathers was 1.37 times higher than those who had educated fathers (adjusted OR = 1.37, 95%CI = 0.78 – 2.42).However, the risk of poor nutritional status among students who had uneducated father decreased after controlling for other factors. In the crude odd ratio, the risk of poor nutritional status among students who had uneducated mothers was 1.65 times higher than those who had educated mother (OR = 1.65, 95% CI = 1.02 – 2.68). While in multivariate analysis, students who had

uneducated mothers had no risk to poor nutritional status than those who had educated mothers.

Family income per year: Students from low income family (<30,000 baht) had higher risk to poor nutritional status by height for age than those from high income family (≥30,000 baht) (adjusted OR =1.63, 95%CI = 0.96 – 2.78). However, the odd ratio of poor nutritional status decreased after controlling other factors.

Mother used alcohol during pregnancy: Students who had mother used alcohol during pregnancy had higher risk to poor nutritional status times than those who had mother did not use alcohol during pregnancy (adjusted OR = 2.01, 95% CI = 1.09 – 3.68). The risk of poor nutritional status decreased after controlling confounding factors.

School absenteeism: Students who had school absenteeism more than 1week had higher risk to poor nutritional status by height for age than those school absenteeism less than 1 week (adjusted OR = 1.46, 95%CI = 0.86 - 2.50). The risk of poor nutritional status decreased after controlling other factors.

Table 4.29 Association between factors and nutritional status (height for age) by Multiple Logistic Regression Analysis

Variable	Nutritional status by height for age		Crude Odds Ratio	P	Adjusted Odd Ratio	P
	Poor (N=122)	Non poor (N=335)				
Ethnicity				0.001*		0.01*
Thai	9(10.8)	74(89.2)	1.00		1.00	
Karen	113(30.2)	261(69.8)	3.56(1.72 – 7.36)		2.78(1.25 – 6.20)	
Age(year)				0.81		0.67
6 – 11 years	64(26.2)	180(73.8)	1.00		1.10(0.70 – 1.70)	
12 – 17 years	58(27.2)	155(72.2)	1.05(0.70 – 1.59)		1.00	
Father's education				0.008*		0.27
Educated	37(20.0)	148(80.0)	1.00		1.00	
Uneducated	85(31.3)	187(68.8)	1.82(1.17 – 2.83)		1.37(0.78 – 2.42)	
Mother's education				0.04*		0.39
Educated	27(20.1)	107(79.9)	1.00		1.00	
Uneducated	95(29.4)	228(70.6)	1.65(1.02 – 2.68)		0.75(0.40 – 1.43)	
Family income per year				0.003*		0.07
≥ 30,000 baht	27(17.9)	124(82.1)	1.00		1.00	
< 30,000 baht	95(31.0)	211(69.0)	2.07(1.28 – 3.35)		1.63(0.96 – 2.78)	
Mother used alcohol during pregnancy				0.008*		0.02*
Non used alcohol	99(24.6)	303(75.4)	1.00		1.00	
Used alcohol	23(41.8)	32(58.2)	2.20(1.23 – 3.94)		2.01(1.09 – 3.68)	
Malaria infected				0.17		0.93
Non malaria infected	80(24.8)	242(75.2)	1.00		1.00	
Malaria infected	42(31.1)	93(68.9)	1.37(0.88 – 2.13)		0.98(0.60 – 1.59)	
School absenteeism				0.05*		0.16
≤ 1 week	92(24.7)	280(75.3)	1.00		1.00	
≥1 week	30(35.3)	55(64.7)	1.66(1.00 – 2.75)		1.46(0.86 - 2.50)	

CHAPTER V
DISCUSSION

This study was conducted among primary-secondary schoolchildren in a school of Tanousri subdistrict, Suanphuang district, Ratchaburi province, Thailand. The study was conducted during January 2014 to May 2014. This study was retrospective cohort study and the history of malaria infection was obtained from medical record of the Rajanagarindra Tropical Diseases Center (RTIC), Suanphung district of Ratchaburi Province, Thailand. Moreover, the primary data was collected by interview. The objective of this study was to determine the association between history of childhood malaria infection and school performance, as well as nutritional status.

5.1 General and socioeconomic characteristics of schoolchildren

Total 457 students were participated in this study. History of childhood malaria infection was recorded in 135 students (30%), all of whom had uncomplicated malaria. The majority of malaria cases were infected with either *Plasmodium falciparum* or *Plasmodium vivax*. Half of students were male and more than half of students were in age group 6-11 years old. Most of them were Karen (82%), and had uneducated father and mother (60% and 70% respectively). The most common average family income per year 10,000 to 20,000 Baht and >30,000 Baht (33% each).Characteristics of students observed in this study are similar to those reported in other rural areas along the Thai international border (6, 16).

5.2 Comparison mean different between groups

This study presented that students who had past history of malaria infection had lower mean of mathematic score than those without history of malaria (mean difference =3.91, p=0.01). This result is consistent with a previous study that reported that children with malaria infection had lower score in mathematic than healthy children (55). Nevertheless, the mean of Thai Language score in this study showed no statistically significant associated with past history of malaria infection (p= 0.19). However, these associations were based on crude analysis, without any adjustment for other potential confounders.

Students who had past history of more malaria attacks had lower mean of mathematic and Thai language score than those without history of malaria infection. Both difference mean in mathematic score and Thai language score showed statistically significant difference to number of malaria attack (p=0.001 and p=0.04 respectively) as well as both of mean in mathematic score and Thai language score decreased with increasing number of malaria attack. Malaria attacks influenced to impairment of cognitive ability which lead to negative and cumulative effects on school performance (51,52). According to previous studies in southern Sri Lanka and Brazil explained that children had experienced more malaria attacks associated with poorer school performance (51,52). Moreover, in previous study found that the mean score both of mathematic and Language decreased with increasing number of malaria attack ($p<0.001$) (51). However, the study suggests that increasing of malaria attack having negative effect related with school performance.

This study found that the mean score of school performance both of mathematic score and Thai Language score were not statistically significant different with duration since last malaria infection (p = 0.72 and p=0.84 respectively). Most of previous studies that showed positive association between childhood malaria infection and school performance were based on short term observation (about 1-2 years after infection (13,51-53,55,58) However, the majority of students in our study (80%) had malaria infection in the last 4-5 years. Therefore, results of our study were more likely represent long-term impact of malaria infection on school performance. Thus, findings could suggest the impact of malaria in children may not last in long term.

Nevertheless, the mean score of emotional intelligence test showed that no statistically significant associated with history of malaria infection (malaria infection, number of malaria attack, and duration since last malaria infection). This study suggests that malaria do not affect to the emotional intelligence of children because emotional intelligence may occur from many factors such as social, environment and culture (103-109).

5.3 Demographic characteristics by malaria group and non malaria group

Male children had greater chance of having malaria infection in the past than female children. This finding is consistent with that found in previous study conducted in Narathiwat province Thailand which most of malaria cases were male (102). In this area, male children are more likely to play outdoors more than female children which may increase the risk of malaria infection. Because this area covers by the forest which is suite for malaria transmission (6,8).Moreover, the results presented that Karen, uneducated parent, and low family incomes were associated with past malaria infection in children. These relationships were also observed in previous studies conducted in endemic areas along the Thai international border (6,16). Poor socioeconomic status may lead to poor household structure, in which mosquitoes can enter the house to seek human more easily (6,8,9,16).

5.4 Malaria infection associated with school performance

This study presented that students who had history of malaria infection had higher risk to poor school performance in term of Mathematic score, Thai Language score, and GPA (OR=1.42, 95%CI = 0.92 – 2.19, OR =1.23, 95%CI= 0.80 – 1.90, and OR=1.70, 95% CI =1.10 – 2.63 respectively). However, these associations were not statistically significant after adjusting for potential confounders, such as age, gender, family income, school absenteeism, and emotional intelligence. Malaria infection may affect neurological cognitive performance and lead to impairments of memory

formation and language function, which have consequence in poor school performance (9,12-14). According to previous studies in Brazil and Sri Lanka showed that malaria infection were associated with poorer school performance, during 1-2 years after infection (51-52,55). Moreover, the risk of poor school performance increased with increasing number of malaria attack. According to study in Sri Lanka found that children with more malaria attacks associated with poorer school performance both of mathematic score and Language ($p<0.001$) (51).These previous findings were different from results of our study that showed no significant different in school performance between students with or without history of malaria infection. These inconsistent results could be explained by different in duration since last malaria infection. In our study, the majority of malaria infected students had last malaria infection more than 3 years ago. Therefore, our findings would be more likely represent long-term impact of malaria infection, rather than short-term impact as observed in the previous studies.

This study showed that only one fourth of students with and without past history of malaria infection had poor nutritional status, indicated by weight for age (23% and 24% respectively) and by height for age (31% and 25% respectively). However, the study presented that no statistically significant associated between childhood malaria infection and nutritional status. This finding differs from the study of *Holding & Kitsao-Wekulo, et al.* in 2004, which explained that children with malaria infection associated with poor nutritional status than healthy children (12). However, this study also evaluated short-term consequence of malaria infection. In summary, our study suggests that effect of uncomplicated malaria infection may not be prolonged, in terms of both school performance and nutritional status.

5.5 Factors associated with school performance

This study found that many factors associated with school performance.

Gender: Male had higher risk to poor school performance (mathematic score, Thai Language score, GPA) than female ($p<0.001$). However, the risk of poor school performance deceased after adjusted for confounding factors. According to previous study in Uganda, it also found that male had higher risk to poor school performance (49). This study suggests that in general, girls are reported to have greater concentration levels during study than boys, perhaps because boys usually are more inclined towards playing or outdoor activities than learning in the classroom. Therefore, girls may perform better than boys in class examinations (103,110). In addition, girls are more likely having good work related to skill in study which induced to better grade in all of subjects than boy (110).

Ethnicity: This study found that students who were Karen had higher risk to poor GPA than students who were Thai. (OR = 1.68, 95%CI = 1.01 – 2.79). Some Karen parents may not be able to speak or write Thai language, which could result in unable to help their children to study at home. Furthermore, Karen students normally use Karen language at home, rather than Thai language. At school, all subjects are taught in Thai Language, so this could be a barrier of learning in school for Karen students. As shown in other areas, students who were ethnic minorities showed that reading deficit and skill deficits (11). However, different ethnicities may have difference culture and learning styles (111).

Parent education: This study found that students who had uneducated parents had higher risk to poor mathematic score than those who had educated parents. It was similar to finding of study in southern Sri Lanka, which children who had less educated parent associated with poorer school performance (52,55). However, only mother education associated with poor school performance in Thai Language and GPA ($p=0.04$ and $p=0.02$ respectively) which students who had uneducated mother had higher risk to poor school performance (Thai Language, GPA) than those who had educated mother. Parent education may involve to school performance of children due to parenting and helping to study of children (117). Many studies suggest that low educated parent may lead to poor school performance and poor work related skill of

children; Because parent support giving the basic of activities which influence to children education outcome (103-105,111-112).

Family income: Student from low income family had higher risk to poor school performance (mathematic score, GPA) than those from high income family (OR = 1.86, 95%CI = 1.24 – 2.79 and OR = 1.89, 96%CI = 1.25 – 2.85 respectively). However, the odd ratio of poor school performance (mathematic, GPA) decreased after controlling for other factors. Socioeconomic status can indirectly influence cognitive development since the early childhood to adolescent (105,111). Socioeconomic status (family income, parent education) is associated with parenting skill which affects skill building activities and school behavior of children. Many previous studies suggested that children with low family income or low socioeconomic status associated with low academic achievement and low intelligence (51,105,111) Nevertheless, the association between family income and school performance was not found in a study conducted in a rural area of the Philippines (50).

School absenteeism: This study presented that school absenteeism associated with poor school performance in Mathematic score, Thai Language score, and GPA ($p=0.003$, $p= 0.009$, $p<0.001$, respectively). Students who had school absenteeism more than 1 week over a semester had higher risk to poor school performance than those who absent from the school less than 1 week. This finding is consistent with a study conducted in Brazilian Amazon which found that school absenteeism associated with poorer school performance (52). Students who are absent from school more often may not be able to catch up knowledge given in classroom. Therefore, these absent students may learn behind other students.

Emotional intelligence: The result presented that low emotional intelligence associated with poor school performance in mathematic score, Thai Language score, and GPA ($p<0.001$). Emotional intelligence may influence to concentration, attention and behaviors of children to learning in school (35-36). Therefore, students with normal emotional intelligence may have high concentration to learning than those with low emotional intelligence. Many studies explained that emotional intelligence may influenced to self control, decision, zeal, and persistence as well as had effects on school performance (35-36, 107-109). However, emotional intelligence involves many factors such as cultural, social.

Gestational age: Students who were born preterm (< 36 weeks) were associated with poor school performance in terms of GPA (p=0.03). Many studies suggested that students with preterm gestational age had poorer school performance than students with term delivery. Preterm gestational age may have effects on reading, spelling, and mathematic disabilities (82-86). Moreover, preterm gestational had related with cognitive impairment, behavior problems, and attention impairment (85).

5.6 Factors associated with nutritional status

Gender: Male had higher risk to poor nutritional status (Weight for Age) than female. Because male usually interest to playing and doing activities which lead to eating is not on time. However, maybe indicate that difference gender have different eating styles and may affect to food intake (113).

Mother use alcohol during pregnancy: Students whom mothers used alcohol during pregnancy were associated with poor nutritional status (Weight for Age, Height for Age). Using alcohol during pregnancy can impair growth of a baby. Normally, the influence of alcohol leads to micronutrient deficiencies due to hypoglycemia, decreased to weight and height from mother to infancy (103, 114).

Socioeconomic status: This study presented that family income and parent education were associated with nutritional status of children. Most people in rural areas had low socioeconomic status (low family income, low educated parents Moreover, mother education level may influence how the mother taking care of their children, which subsequently affect nutritional status of children. Furthermore, low socioeconomic status may relate to poor food consumption due to lack of water and poor food supplies (70-73,105,111).

Ethnicity: This study found that the risk of poor nutritional status by height for age among students who were Karen was 3.56 times higher than those who were Thai (OR= 3.56, 95%CI = 1.72 – 7.36). In previous study suggest that difference ethnicity had different characteristics which influence to growth of children (114).

Birth weight: This study found that students among low birth weight had associated with poor nutritional status (Weight for Age) (p=0.02). In previous studies explained that low birth weight had long term effects to nutrient deficits until

childhood. Furthermore, low birth weight may affect to impairments of growth, structure function, and muscle (115,116).

5.7 Strengths of the study

1) This retrospective cohort study allows us to assess temporal relationship between malaria infection with school performance and nutritional status.

2) Most previous studies followed effect of malaria infection on school performance in short-term, such as cross sectional study or short duration of cohort study. However, little knowledge had known about long-term impact of malaria infection. For this reason, the study was assessed long-term impact of malaria infection in children on school performance and nutritional status with about 10 years of retrospective cohort study. This study tracked the history of malaria infection since birth, which provides information on the long-term consequences of uncomplicated malaria in children living in an area of low malaria transmission.

3) This study used medical history childhood malaria infection and parasite infection from Rajanagarindra Tropical Diseases Center (RTIC), located in western border of Thailand. The only one malaria clinic in the area; all malaria cases occurred in the area usually are detected at this center so the databases were complete and valid.

4) In this study, data on history of malaria infection in students were obtained from the only malaria clinic in the area. The village census record that has been regularly updated was used to identify students who permanently live in the area but did not have malaria infection. Using these data sources helped to ensure the validity of the past malaria status of our subjects.

5) School performance status was classified using a standardized score to avoid bias that might occur because of variation in standard grading by different teachers in different classrooms.

5.8 Limitation of the study

The cause of poor school performance is multifactorial. Although several potential confounders have been explored and adjusted in this study, some variables may be left unadjusted, such as underlying diseases of students and the learning environment outside school. However, most of the students in the study were healthy; chronic diseases were not observed in this study population. In addition, the variation in the learning environment outside school in this rural area is less likely than in urban areas where competition and learning opportunities are greater.

This study was conducted in a setting of low malaria transmission where the majority of the population is Karen, a minority group. Therefore, results from this study may not be generalizable to children living in hyperendemic areas or in other urban settings.

This study excluded children who did not attend the school, children with disability, and neurological problem. This may cause selection bias in this study, if those who did not attend the school due to their limited learning ability were more likely to have history of malaria infection. However, only small number of children in this area did not attend the school.

CHAPTER VI
CONCLUSION

This retrospective cohort study was conducted during January 2014 to May 2014 among 457 students at primary-secondary schoolchildren in a school of Tanousri subdistrict, Suanphuang district, Ratchaburi province, Thailand. History of malaria infection was obtained from the medical record of the Rajanagarindra Tropical Diseases Center (RTIC), Suanphung district of Ratchaburi Province, Thailand. However, childhood malaria infection was found in 135 students and without malaria infection 322 students, all of whom had uncomplicated malaria. The goals of study were to analyze the association between history of childhood malaria infection with school performance and nutritional status among schoolchildren.

Totally 457 students were participants in the study. Among those 52%were male. More than half of students were in age group 6-11 years old. The majority of students were Karen and low socioeconomic status (uneducated parent, low family income). However, the majority of students had normal nutritional status while only 39% of students had low emotional intelligences. Moreover, male children had about 1.67 times greater chance of having malaria infection in the past than female children and the children who had low socioeconomic status had higher risk to having history of malaria infection.

Malaria infection can affect to cognitive function and lead to impairment of memory and language functions. Moreover, malaria attacks influenced to impairment of cognitive ability which lead to negative and cumulative effects on school performance. This study found that students who had history of malaria infection had lower mean score of mathematic and Thai language than those without history of malaria infection as well as both of mean in mathematic score and Thai Language score decreased with increasing to number of malaria attack. Our findings suggested that past history of malaria infection was associated with poor school performance. However, the association was not significant after controlling for

potential confounders, such as nutritional status, age, gender, and socioeconomic status. The school performance was also not associated with duration since last malaria infection, indicating that the impact of malaria infection on school performance may not last long. Nevertheless, the mean score of emotional intelligence test showed no associated with history of malaria infection (malaria infection, number of malaria attack, and duration since last malaria infection). In addition, childhood malaria infection was also no statistically significant associated with poor nutritional status. This study characterizes the long-term consequences of uncomplicated malaria disease during childhood. School performance and nutritional status were not associated with a history of malaria infection, considering that most students had their last malaria infection more than 2 years previously. These findings indicate that the impact of uncomplicated malaria infection on school performance and nutritional status may not be prolonged.

6.1 Recommendations from the finding of the study

1) Our findings would be useful to health personnel regarding about the characteristics of children who are at risk to malaria infection. This knowledge would be helpful for improving and support well-being of children living in malaria endemic areas.

2) The results of other factors that associated with poor school performance would be useful for improving effective education program that fit to students.

3) Our study suggested that emotional intelligence may influence to concentration, attention and behaviors of children to learning in school. The findings provide the information to parent for parenting their children for good emotional intelligence including goodness, acuteness, and happiness. Furthermore, the good emotional intelligence may increase to school performance.

6.2 Recommendations for further studies

1) This study was conducted only in one malaria endemic area, the results may be limited. Therefore, study areas in the further should be in other malaria endemic areas with similar objectives in this study for comparison to difference geography.

2) The impact of malaria infection was assessed based on any malaria infection, regardless *Plasmodium spp.* Further study may be needed to evaluate the impact of malaria infection by species, as well as by severity of the disease.

3) Future study should assess intelligence quotient (IQ) by Wechsler Intelligence Scale for Children-III (WISC III), this is special test including verbal scales, performance scales, and full scale IQ which should assess by psychologist for in depth school performance. Thus, the study further should collaborate to multidisciplinary.

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APPENDICES

APPENDIX A

QUESTIONNAIRE

ID | | | |

Questionnaire

The characteristics of children in primary secondary school

at rujirapath school of Tanousrisubdistric, Suanphuang district,

Ratchaburi province, Thailand

Explanation: You writing✓in the ( ) or add the data in the gaps following to real data

1. Gender ( ) 1. Male ( ) 2. Female

2. Age……..years old

3. Hamlet of student……

4. Ethnicity ( ) 1.Thai ( ) 2. Karen

5. What does your father education?

( ) 1. Uneducated ( ) 2.Primary school

( ) 3.High school ( ) 4.Diploma or equivalent

( ) 5.Bachelor degree ( ) 6. Other (assign)…….

6. What does your mother education?

( ) 1. Uneducated ( ) 2. Primary school

( ) 3. High school ( ) 4.Diploma or equivalent

( ) 5.Bachelor degree ( ) 6. Other (assign)…….

7. Average income of your family?

( ) 1. Enough ( ) 2. Non-enough

8. Average income of your family per year?

( ) 1. Less than 10,000 baht per year ( ) 2. 10,000 –20,000 baht per year

( ) 3. 20,001 – 30,000 baht per year ( ) 4. More than30,000 baht per year

9. Does your mother use alcohol during pregnancy?

( ) 1. Used alcohol ( ) 2. Non-used alcohol

10. Doses your mother smoking?

( ) 1. Smoking ( ) 2. Non-smoking

11. Doses your father smoking?

( ) 1. Smoking ( ) 2. Non-smoking

Antenatal history (from an ANC book)

12. Birth weight…….gram

13. Gestational age at birth…….....weeks

14. History of complication during birth?

( ) 1. No complication ( ) 2.Complication (assign)…….

15. Have received complete vaccination?

( ) 1. Completed ( ) 2. Non-completed

ID | | |

แบบสอบถาม

ข้อมูลทั่วไปของนักเรียนชั้นประถมศึกษาและมัธยมศึกษา

โรงเรียนรุจิรพัฒน์ ตำบลตะนาวศรี อำเภอสวนผึ้ง จังหวัดราชบุรี

คำชี้แจง ให้นักเรียนทำเครื่องหมาย✓ลงใน ( ) หรือเติมข้อความลงในช่องว่างตามความเป็นจริง

1. เพศ ( ) 1. ชาย ( ) 2. หญิง

2. อายุ…….ปี

3. อาศัยอยู่ในหมู่บ้าน.....

4. เชื้อชาติ

( ) 1. ไทย ( ) 2. กระเหรี่ยง

5.คุณพ่อของนักเรียนจบการศึกษาชั้นอะไร

( ) 1. ไม่ได้รับการศึกษา ( ) 2. ประถมศึกษา

( ) 3. มัธยมศึกษา ( ) 4. อนุปริญญาหรือเทียบเท่า

( ) 5. ปริญญาตรี ( ) 6. อื่น ๆ (โปรดระบุ)…….

6.คุณแม่ของนักเรียนจบการศึกษาชั้นอะไร

( ) 1.ไม่ได้รับการศึกษา ( ) 2. ประถมศึกษา

( ) 3. มัธยมศึกษา ( ) 4. อนุปริญญาหรือเทียบเท่า

( ) 5. ปริญญาตรี ( ) 6. อื่น ๆ (โปรดระบุ)…….

7.รายได้เฉลี่ยของครอบครัว

( ) 1.เพียงพอ ( ) 2.ไม่เพียงพอ

8. รายได้เฉลี่ยของครอบครัวต่อปี

( )1. น้อยกว่า 10,000 บาทต่อปี ( )2.10,000 –20,000 บาทต่อปี

( ) 3.20,001 – 30,000 บาทต่อปี ( ) 4.มากกว่า 30,000 บาทต่อปี

9. คุณแม่ของนักเรียนดื่มแอลกอฮอล์ขณะตั้งครรภ์หรือไม่

( ) 1.ดื่มแอลกอฮอล์ ( ) 2.ไม่ดื่มแอลกอฮอล์

10. คุณพ่อของนักเรียนสูบบุหรี่หรือไม่

( ) 1.สูบบุหรี่ ( ) 2.ไม่สูบบุหรี่

11. คุณแม่ของนักเรียนสูบบุหรี่หรือไม่

( ) 1. สูบบุหรี่ ( ) 2.ไม่สูบบุหรี่

ประวัติการฝากครรภ์ (จากหนังสือ ANC)

12. น้ำหนักแรกคลอดของนักเรียน..... กรัม

13อายุครรภ์ที่คลอด..... สัปดาห์

14.นักเรียนมีภาวะแทรกซ้อนในระหว่างการคลอดหรือไม่

( ) 1.ไม่มีภาวะแทรกซ้อน ( ) 2.มีภาวะแทรกซ้อน (โปรดระบุ).....

15.นักเรียนได้รับการฉีดวัคซีนครบถ้วนหรือไม่

( ) 1. ครบถ้วน ( ) 2.ไม่ครบถ้วน

APPENDIX B

EMOTIONAL INTELLIGENCE TEST FOR CHILDREN AGE 6-11 YEARS

The assessment of emotional intelligence for children aged 6-11 years for teacher

This message explained emotion and behavior of children in during the past four months. Please select the answer that you think is the match the most children.

Information	Not at all	Sometimes	Often	Always
1. Do not used force when angry or offensive				
2. Know wait for their time when not time for their				
3. Deterrent to doing their own whim				
4.When you need something must be get right now				
5. When anger take longer time for thaw				
6. Obsessed excessive playing				
7. Reason instead to fore				
8. Help protect and assist younger children				
9. Compassion when others suffer				
10. Pay attention know that who like and dislike this				
11. Relied of friends when friend require to help				
12. Careful or not to cause any trouble or distress				
13. Not help or do not cooperate with others				
14. Encourage to others				
15. Get to know of others				
16. Show concern for others				
17. Often confess when done wrong				
18. Do not like fake friends				
19. Agree that faults when asked				
20. When done wrong and excused to not intended				
21. Accept to rule such as accept to punished when done wrong				
22.Know to apologized				
23. Accept to blame or admonish when done wrong				
24. Intentions to something that interesting				

Information	Not at all	Sometimes	Often	Always
25. Concentrate to done or work such as reading book to longtime				
26. Try to work hard to successfully on their own such as problem of homework, handicraft				
27. Enjoys solving to difficult problems or challenge such problem homework, strange new toy				
28. Logy not interesting to work for successful				
29. Complain or bargain that the work is difficult, since not done.				
30. Continue to run until the finish although friend go to play				
31. Do not be discouraged when faced with disappointment				
32. Find a way to deal with friends or other children when occurrence to conflict				
33. Not bawl when met to problems or difficulty				
34. Know to wait rhythm or wait for the right time for the solve to problems				
35.When met the problem, find many way for solve that problems				
36. Activity although don't like it or not bold to participant with others				
37. Greet or make new friends				
38. Show the assertive and presence to many people				
39. Brave asked to question when to have doubt				
40. When asked using quiet for answers that don't know				
41. Often used excuse when not dare do anything				
42. Dare not leave comments with others				
43. Described their success to adult audience				
44. Does not shy of what they have such as status of home, occupation of the parents, aspect, their own ability				
45. Proud to own a good point or some special ability such as clever, good at sport, playing music				
46.Pround the trust from adult such as take care younger, take care pet, help for adults				
47. Easy to offense				
48. Disappoint when don't fight with others				
49. Delight with the results of the study although it is not very good.				
50. When not what they want acceptable as of substitutes for each other				

Information	Not at all	Sometimes	Often	Always
51. Even defeated games or sports do not regret it				
52. Even some things that are not necessary demands that will be required				
53. Long frustrated when not in my mind				
54. When do not want to be so very disappointed such as complain, groan or depress				
55. Humor				
56. Playing funny				
57. When alone find yourself enjoying it				
58. Know to relaxing to watching a movie, listen to music, playing, paint, talk with friends				
59. good-tempered, smile easier, laughing easier				
60. Enjoy the race despite knowing that did not win				

แบบประเมินความฉลาดทางอารมณ์ เด็กอายุ 6-11 ปี สำหรับครู

คำแนะนำ

ข้อความต่อไปนี้เป็นการอธิบายถึงอารมณ์ ความรู้สึกและพฤติกรรมของเด็กในช่วง 4 เดือนที่ผ่านมา โปรดเลือกคำตอบที่ท่านคิดว่าตรงกับตัวเด็กมากที่สุด

ข้อ	ไม่เป็นเลย	เป็นบางครั้ง	เป็นบ่อยครั้ง	เป็นประจำ
1. ไม่ใช้กำลังเวลาโกรธหรือไม่พอใจ				
2. รู้จักรอคอยเมื่อยังไม่ถึงคราวหรือเวลาของตน				
3. ยับยั้งที่จะทำอะไรตามอำเภอใจตนเอง				
4. ต้องการอะไรต้องได้ทันที				
5. เมื่อมีอารมณ์โกรธ ต้องใช้เวลานานกว่าจะหายโกรธ				
6. หมกมุ่นกับการเล่นมากเกินไป				
7. ชี้แจงเหตุผลแทนการใช้กำลัง				
8. ช่วยปกป้อง ดูแล และช่วยเหลือเด็กที่เล็กกว่า				
9. เห็นอกเห็นใจเมื่อผู้อื่นเดือดร้อน				
10. ใส่ใจหรือรู้ว่าใครชอบอะไร ไม่ชอบอะไร				
11. เป็นที่พึ่งได้เมื่อเพื่อนต้องการความช่วยเหลือ				
12. ระมัดระวังที่จะไม่ทำให้ผู้อื่นเดือดร้อนหรือเสียใจ				
13. ไม่ช่วยเหลือหรือไม่ให้ความร่วมมือกับผู้อื่น				
14. รู้จักให้กำลังใจผู้อื่น				
15. รู้จักรับฟังผู้อื่น				
16. รู้จักแสดงความห่วงใยผู้อื่น				
17. มักสารภาพเมื่อทำผิด				
18. ไม่ชอบแกล้งเพื่อน				
19. ยอมรับว่าผิดเมื่อถูกถาม				
20. เมื่อทำผิด มักแก้ตัวว่าไม่ได้ตั้งใจ				
21. ยอมรับกฎเกณฑ์ เช่น ยอมรับการลงโทษเมื่อทำผิด				
22. รู้จักขอโทษ				
23. ยอมรับคำตำหนิหรือตักเตือนเมื่อทำผิด				
24. มีความตั้งใจเมื่อทำสิ่งต่างๆ ที่สนใจ				
25. มีสมาธิในการทำงาน เช่น อ่านหนังสือได้นานๆ				

ข้อ	ไม่เป็นเลย	เป็นบางครั้ง	เป็นบ่อยครั้ง	เป็นประจำ
26. พยายามทำงานที่ยากให้สำเร็จได้ด้วยตนเอง เช่น การบ้าน การฝีมือ				
27. สนุกกับการแก้ปัญหายากๆ หรือท้าทาย เช่น ปัญหาการบ้าน ของเล่นที่แปลกๆ ใหม่ๆ				
28. เฉื่อยชา ไม่สนใจที่จะทำงานให้เสร็จ				
29. บ่นหรือต่อรองว่างานต่างๆ ยากเกินกว่าที่จะทำได้ทั้งๆ ที่ยังไม่ได้ลงมือทำ				
30. ทำงานต่อไปจนเสร็จแม้ว่าเพื่อนๆ ไปเล่นแล้วก็ตาม				
31. ไม่ท้อใจเมื่อประสบกับความผิดหวัง				
32. หาทางตกลงกับเพื่อนหรือเด็กคนอื่นเมื่อเกิดขัดแย้งกัน				
33. ไม่เอะอะโวยวายเมื่อพบปัญหาหรือความยุ่งยาก				
34. รู้จักรอจังหวะหรือรอคอยเวลาที่เหมาะสมในการแก้ปัญหา				
35. เมื่อมีปัญหา จะคิดหาวิธีแก้หลายๆ ทาง				
36. ร่วมกิจกรรมที่ตนไม่ชอบ หรือไม่ถนัดกับผู้อื่นได้				
37. ทักทายหรือทำความรู้จักกับเพื่อนใหม่				
38. กล้าแสดงความสามารถที่มีอยู่ต่อหน้าคนหมู่มาก				
39. กล้าซักถามข้อสงสัย				
40. เมื่อถูกถาม ใช้วิธีนิ่งเฉย แทนการตอบว่าไม่รู้				
41. มักจะใช้ข้ออ้างเมื่อไม่กล้าทำอะไร				
42. ไม่กล้าออกความเห็นเมื่ออยู่กับผู้อื่น				
43. เล่าถึงความสำเร็จของตนเองให้ผู้ใหญ่ฟัง				
44. ไม่อายในสิ่งที่ตนมีอยู่ เช่น ฐานะบ้าน อาชีพของพ่อแม่ รูปร่างหน้าตา ความสามารถของตนเอง ฯลฯ				
45. ภูมิใจที่ตนเองมีจุดดีหรือความสามารถพิเศษบางอย่าง เช่น เรียนเก่ง เล่นกีฬาเก่ง เล่นดนตรีได้				
46. ภูมิใจที่ได้รับความไว้วางใจจากผู้ใหญ่ เช่น ดูแลน้อง ดูแลสัตว์เลี้ยง ช่วยเหลืองานผู้ใหญ่				
47. น้อยใจง่าย				
48. รู้สึกน้อยเนื้อต่ำใจที่สู้คนอื่นไม่ได้				
49. พอใจกับผลการเรียนที่ได้ แม้จะไม่ดีเด่นมากนัก				

ข้อ	ไม่เป็นเลย	เป็นบางครั้ง	เป็นบ่อยครั้ง	เป็นประจำ
50. เมื่อไม่ได้สิ่งที่ต้องการก็รู้จักยอมรับสิ่งทดแทนอย่างอื่นได้				
51. แม้เกมหรือกีฬาแพ้ก็ไม่เสียใจนาน				
52. แม้เป็นสิ่งที่ไม่จำเป็นก็เรียกร้องที่จะเอาให้ได้ตามที่ต้องการ				
53. หงุดหงิดอยู่นานเมื่อไม่ได้ดั่งใจ				
54. เมื่อทำอะไรไม่ได้ตามต้องการจะผิดหวังมาก เช่น บ่น คร่ำครวญ หรือซึม				
55. มีอารมณ์ขัน				
56. เล่นสนุกสนานหรือล้อกันเล่นสนุกๆ ได้				
57. เมื่ออยู่คนเดียวก็รู้จักหาสิ่งมาทำให้ตัวเองเพลิดเพลินได้				
58. รู้จักผ่อนคลายอารมณ์ด้วยการดูหนัง ฟังเพลง เล่นสนุก วาดรูป พูดคุยกับเพื่อน				
59. เป็นคนแจ่มใส ยิ้มง่าย หัวเราะง่าย				
60. สนุกกับการแข่งขันแม้จะรู้ว่าไม่ชนะ				

APPENDIX C

EMOTIONAL INTELLIGENCE TEST FOR CHILDREN AGE 12-17 YEARS

The assessment of emotional intelligence for children aged 12-17 years

This message explained emotion and behavior of children in during the past four months. Please select the answer that you think is accordingly the most of you.

Information	Not at all	Sometime	Often	Always
1.When angry or uncomfortable, I know what happened to me				
2. I can't say, what I makes angry				
3. When displease I often feel irritated and not control their emotions				
4. I can be waiting for achieve and complacent				
5. I often react violently to the little problem.				
6. When forced to do something that dislike, I will explain reason to others accept				
7. I observed when close people having emotional changes				
8. I am not interested for the suffering of others that I do not recognize				
9. I do not accept when the others are doing different from my thinking				
10. I accept that others may have reason to be dissatisfied of my actions				
11. I feel that others like the attention to much				
12. Despite the obligation to do I'm welcome to listen to the suffering of others who need to help				
13. Is common to exploit from others if possible				
14. I appreciate the kindness of others for me.				
15. When done wrong, I can say the word "sorry" for someone else				
16. I can be difficult that accept the errors of others				
17. Despite having some personal advantage, I was willing to do for participate				

Information	Not at all	Sometime	Often	Always
18. I uncomfortable for doing something for others.				
19. I don’t know, what I'm good at				
20. Despite a difficult task, I'm sure that can be done				
21. When to do anything failed. I felt discouraged				
22. I esteem of something that I do fully ability				
23. When faced with obstacles, disappointments I will not surrender				
24. When starting of anything. I usually do, without success				
25. I tried to find the real cause of the problem by not assume follow to like				
26. Often, I do not know what made me unhappy				
27. I feel that the decision to solve problems, was difficult for me				
28. When need to do many things at the same time. I decide if to do before and the latter				
29. I was embarrassment When I have to live with strangers or unfamiliar people				
30. I can’t bear When live in a society that contrary to rules of my wont				
31. I easily make friends with other people				
32. I have several close friends that dating for long time				
33. I did not dare tell my need for others to know				
34. I do things that want without making afflicted to others				
35. It is difficult for me to argue with others. Despite sufficient reason				
36. When disagreeing with others. I can explain reason why he accepted				
37. I feel inferior to others				
38. I served well. Whether it is in any role				
39. I was assigned to work the best				
40. I'm not sure of the difficult work				
41. The situation is even worse. I hope that will be better				
42. Every problem always has a solution				
43. When stress, I always change the subject to relax or have fun.				
44. I enjoyed all the activities on weekends and holidays				

Information	Not at all	Sometime	Often	Always
45. I was not satisfied that others get something better than me				
46. I am satisfied with what I was				
47. I do not know what to do. When tired				
48. When abstained from duty. I will do something that I like				
49. When you feel uncomfortable. I have a relaxed mood				
50. I can relax themselves, Despite tired to responsibility				
51. I can not bring himself to happy until they have everything they need				
52. I always worry about the little things that always happen				

แบบประเมินความฉลาดทางอารมณ์ เด็กอายุ 12 -17 ปี

คำแนะนำ

ข้อความต่อไปนี้เป็นการอธิบายถึงอารมณ์ ความรู้สึกและพฤติกรรมของ ท่านในช่วง 4 เดือนที่ผ่านมา โปรดเลือกคำตอบที่ท่านคิดว่าตรงกับท่านมากที่สุด

ข้อ	ไม่เป็นเลย	เป็นบางครั้ง	เป็นบ่อยครั้ง	เป็นประจำ
1. เวลาโกรธหรือไม่สบายใจ ฉันรับรู้ได้ว่าเกิดอะไรขึ้นกับฉัน				
2. ฉันบอกไม่ได้ว่าอะไรทำให้ฉันรู้สึกโกรธ				
3. เมื่อถูกขัดใจ ฉันมักรู้สึกหงุดหงิดจนควบคุมอารมณ์ไม่ได้				
4. ฉันสามารถคอยเพื่อให้บรรลุเป้าหมายที่พอใจ				
5. ฉันมักมีปฏิกิริยาโต้ตอบรุนแรงต่อปัญหาเพียงเล็กน้อย				
6. เมื่อถูกบังคับให้ทำในสิ่งที่ไม่ชอบ ฉันจะอธิบายเหตุผลจนผู้อื่นยอมรับได้				
7. ฉันสังเกตได้ เมื่อคนใกล้ชิดมีอารมณ์เปลี่ยนแปลง				
8. ฉันไม่สนใจกับความทุกข์ของผู้อื่นที่ฉันไม่รู้จัก				
9. ฉันไม่ยอมรับในสิ่งที่ผู้อื่นทำต่างจากที่ฉันคิด				
10. ฉันยอมรับได้ว่าผู้อื่นก็อาจมีเหตุผลที่จะไม่พอใจการกระทำของฉัน				
11. ฉันรู้สึกว่าผู้อื่นชอบเรียกร้องความสนใจมากเกินไป				
12. แม้จะมีภาระที่ต้องทำ ฉันก็ยินดีรับฟังความทุกข์ของผู้อื่นที่ต้องการความช่วยเหลือ				
13. เป็นเรื่องธรรมดาที่จะเอาเปรียบผู้อื่นเมื่อมีโอกาส				
14. ฉันเห็นคุณค่าในน้ำใจที่ผู้อื่นมีต่อฉัน				
15. เมื่อทำผิด ฉันสามารถกล่าวคำ “ขอโทษ” ผู้อื่นได้				
16. ฉันยอมรับข้อผิดพลาดของผู้อื่นได้ยาก				
17. ถึงแม้จะต้องเสียประโยชน์ส่วนตัวไปบ้าง ฉันก็ยินดีที่จะทำเพื่อส่วนรวม				
18. ฉันรู้สึกลำบากใจในการทำสิ่งใดสิ่งหนึ่งเพื่อผู้อื่น				
19. ฉันไม่รู้ว่าฉันเก่งเรื่องอะไร				
20. แม้จะเป็นงานยาก ฉันก็มั่นใจว่าสามารถทำได้				
21. เมื่อทำสิ่งใดไม่สำเร็จ ฉันรู้สึกหมดกำลังใจ				

ข้อ	ไม่เป็นเลย	เป็นบางครั้ง	เป็นบ่อยครั้ง	เป็นประจำ
22. ฉันรู้สึกมีคุณค่าเมื่อได้ทำสิ่งต่างๆ อย่างเต็มความสามารถ				
23. เมื่อต้องเผชิญกับอุปสรรคและความผิดหวัง ฉันก็จะไม่ยอมแพ้				
24. เมื่อเริ่มทำสิ่งหนึ่งสิ่งใด ฉันมักทำต่อไปไม่สำเร็จ				
25. ฉันพยายามหาสาเหตุที่แท้จริงของปัญหาโดยไม่คิดเอาเองตามใจชอบ				
26. บ่อยครั้งที่ฉันไม่รู้ว่าอะไรทำให้ฉันไม่มีความสุข				
27. ฉันรู้สึกว่าการตัดสินใจแก้ปัญหาเป็นเรื่องยากสำหรับฉัน				
28. เมื่อต้องทำอะไรหลายอย่างในเวลาเดียวกัน ฉันตัดสินใจได้ว่าจะทำอะไรก่อนหลัง				
29. ฉันลำบากใจเมื่อต้องอยู่กับคนแปลกหน้าหรือคนที่ไม่คุ้นเคย				
30. ฉันทนไม่ได้เมื่อต้องอยู่ในสังคมที่มีกฎระเบียบขัดกับความเคยชินของฉัน				
31. ฉันทำความรู้จักผู้อื่นได้ง่าย				
32. ฉันมีเพื่อสนิทหลายคนที่คบกันมานาน				
33. ฉันไม่กล้าบอกความต้องการของฉันให้ผู้อื่นรู้				
34. ฉันทำในสิ่งที่ต้องการโดยไม่ทำให้ผู้อื่นเดือดร้อน				
35. เป็นการยากสำหรับฉันที่จะโต้แย้งกับผู้อื่น แม้จะมีเหตุผลเพียงพอ				
36. เมื่อไม่เห็นด้วยกับผู้อื่น ฉันสามารถอธิบายเหตุผลที่เขายอมรับได้				
37. ฉันรู้สึกด้อยกว่าผู้อื่น				
38. ฉันทำหน้าที่ได้ดี ไม่ว่าจะอยู่ในบทบาทใด				
39. ฉันสามารถทำงานที่ได้รับมอบหมายได้ดีที่สุด				
40. ฉันไม่มั่นใจในการทำงานที่ยากลำบาก				
41. แม้สถานการณ์จะเลวร้าย ฉันก็มีความหวังว่าจะดีขึ้น				
42. ทุกปัญหามักมีทางออกเสมอ				
43. เมื่อมีเรื่องที่ทำให้เครียด ฉันมักปรับเปลี่ยนให้เป็นเรื่องผ่อนคลายหรือสนุกสนานได้				

ข้อ	ไม่เป็นเลย	เป็นบางครั้ง	เป็นบ่อยครั้ง	เป็นประจำ
44. ฉันสนุกสนานทุกครั้งกับกิจกรรมในวันสุดสัปดาห์และวันหยุดพักผ่อน				
45. ฉันรู้สึกไม่พอใจที่ผู้อื่นได้รับสิ่งดีๆ มากกว่าฉัน				
46. ฉันพอใจกับสิ่งที่ฉันเป็นอยู่				
47. ฉันไม่รู้ว่าจะหาอะไรทำ เมื่อรู้สึกเบื่อหน่าย				
48. เมื่อว่างเว้นจากภาระหน้าที่ ฉันจะทำในสิ่งที่ฉันชอบ				
49. เมื่อรู้สึกไม่สบายใจ ฉันมีวิธีผ่อนคลายอารมณ์ได้				
50. ฉันสามารถผ่อนคลายตนเองได้ แม้จะเห็ดเหนื่อยจากภาระหน้าที่				
51. ฉันไม่สามารถทำใจให้เป็นสุขได้จนกว่าจะได้ทุกสิ่งที่ต้องการ				
52. ฉันมักทุกข์ร้อนกับเรื่องเล็กๆ น้อยๆ ที่เกิดขึ้นเสมอ				

APPENDIX D

ETHICAL APPROVAL

MUTM 2014-004-01

CERTIFICATE OF ETHICAL APPROVAL
Ethics Committee of the Faculty of Tropical Medicine, Mahidol University
420/6 Ratchawithi Rd., Ratchatheewee, Bangkok 10400, Thailand

This Certificate of Ethical Approval (MUTM 2014-004-01) applies to the

Project entitled: Long-term impact of childhood malaria infection on school performance and anthropometric indicides among schoolchildren in a malaria endemic area along the Thai-Myanmar border

EC Submission No.: TMEC 13-096

with the following relevant documents:

1) Research proposal (FTM ECF-019-02); English version 2 date 10 January 2014
2) Participant Information Sheet for parent (FTM ECF-020-00); Thai version 2 date 10 January 2014
3) Participant Information Sheet for student aged > 13 years (FTM ECF-020-00); Thai version 2 date 10 January 2014
4) Informed Consent Form for parent of children aged 7- < 13 years or aged < 7 years (FTM ECF-021-02); Thai version (date not affixed)
5) Informed Consent Form for participant aged 18 years and over or children aged 13 years - < 18 years (FTM ECF-021-02); Thai version (date not affixed)
6) Informed Assent Form (FTM ECF-022-01); Thai version (date not affixed)
7) Questionnaire; Thai version (date not affixed)
8) Questionnaire; English version (date not affixed)
9) Emotional intelligence evaluation form (children aged 6-11 years) for teacher; Thai version (date not affixed)
10) Emotional intelligence evaluation form for children aged 12-17 years; Thai version 2 date 10 January 2014

Principal Investigator: Ms. Nutchavadee Vorasan

Advisor: Asst. Prof. Dr. Saranath Lawpoolsri Niyom

Affiliation: Department of Tropical Hygiene,
Faculty of Tropical Medicine, Mahidol University

MUTM 2014-004-01

This project has been approved for the period
from 20 January 2014 to 19 January 2015

The Ethics Committee of Faculty of Tropical Medicine certify that we are in compliance with Declaration of Helsinki, ICH Guidelines for Good Clinical Practice and other International Guidelines for Human Research Protection.

Signature .....
(Prof. Dr. Srisin Khusmith)
Chairperson (Panel 2)
Ethics Committee of the
Faculty of Tropical Medicine
Date ....23 JAN 2014

Signature .....
(Mrs. Pornpimon Adams)
Member and Secretary
Ethics Committee of the
Faculty of Tropical Medicine
Date ....23 JAN 2014

BIOGRAPHY

NAME	Nutchavadee Vorasan
DATE OF BIRTH	1 March 1990
PLACE OF BIRTH	Nakhonsawan, Thailand
INSTITUTIONS ATTENDED	Mahidol University, Bachelor of Science (Public Health) Mahidol University, Master of Science (Tropical Medicine), Major of epidemiology
RESEARCH GRANTS	Faculty of Tropical Medicine, Mahidol University
HOME ADDRESS	209/1 Nongpho subdistrict, Takhli district, Nakhonsawan, Thailand Tel: 056-338-099 E-mail: nutchavadee.voa@student.mahidol.ac.th